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U. S. ARMY MATERIEL COMMAND

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TRANSLATION

MANUAL ON THE LAYING AND CLEARING OF MINEFIELDS

COUNTRY: USSR

U S ARMY
FOREIGN SCIENCE
AND
TECHNOLOGY
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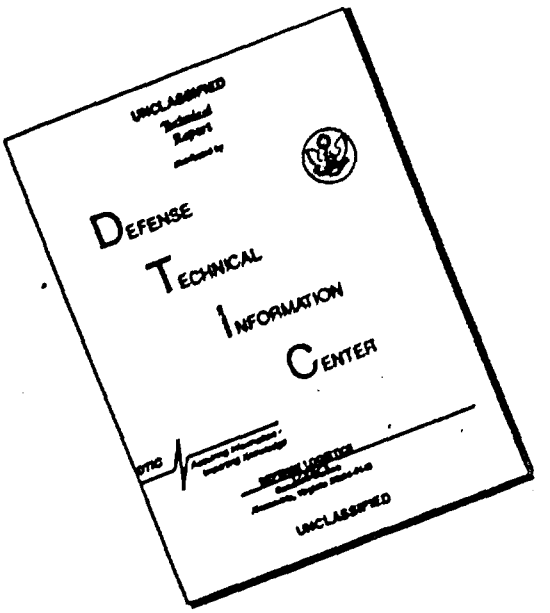

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Manual on the Laying and Clearing of Minefields

by

P. G. RADEVICH, V. V. ZHURAVLEV and I. V. VOLKOV

English Pages: 138

Source: POSOBIYE PO USTROYSTVU I PREODOLENIYU MINNO-VZRYVNYKH ZAGRAZHDENIY, Moscow, 1965.

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MANUAL ON THE LAYING AND CLEARING OF MINEFIELDS

/Following is the translation of a Russian-language book entitled Posobiye po Ustroystvu i Preodoleniyu Minno-Vzryvnykh Zagrazhdeniy (English version above) by P.G. Radevich, V.V. Zhuravlev, and I.V. Volkov, Military Publishing House of the Ministry of Defense USSR, Moscow, 1965, pages 1 - 163./

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This book describes the designs and operating principles of antitank and antipersonnel mines of the Soviet Army and the armies of the capitalist states. The fundamentals of laying, reconnaissance and clearing of minefields, as well as recommendations for their recording and simulation, are also covered. Methods of organizing the training of personnel are described along with the safety rules that must be observed in laying and clearing mines.

The book may be used as an aid by officers in all branches of the armed forces, by cadets in military schools, and by non-commissioned officers and soldiers of the Soviet Army.

The book will also be useful to reserve officer affiliated with engineer units.

INTRODUCTION

Combat operations under present day conditions are exceptionally maneuverable and fast moving. Nuclear missiles are the principal fire weapons to be used against the enemy. Success in combat, however, is achieved by the combined efforts of all branches of the armed forces, with particular emphasis on the tank and mechanized units. Tanks have become the main striking units of the land forces and their role is constantly increasing. NATO divisions of today have hundreds of tanks and several thousands of other combat and transport vehicles. Therefore the significance of all the means of antitank warfare has increased in general and that of antitank obstacles in particular.

The most effective type of antitank obstacles are mined obstacles and, primarily, minefields. They are capable of putting enemy manpower and combat materiel out of commission, at the same time affecting the morale of enemy troops. Mines are quickly installed with the aid of various devices and are easily camouflaged, which complicates their reconnaissance and clearing. The mines are always armed and require no servicing once installed. They have a high degree of resistance against the effects of nuclear weapons. The unit personnel usually have more confidence if the approaches to their positions are mined.

During the Great Patriotic War mined obstacles were employed on a very large scale. The troops of the Voronezh Front installed as many as 400,000 antitank and more than 300,000 antipersonnel mines during battles along the Kursk Arc alone. These mines destroyed hundreds of enemy tanks, armored personnel carriers and other motor vehicles.

The history of the past war provides quite a few examples w when various units layed minefields through their own efforts, and also cleared paths not only through their own minefields but through enemy minefields as well.

Commanders of units engaged in combat are best informed of the current situation, the terrain, the antitank fire system as well as the most vulnerable spots of the positions occupied by units under their command. This permits them to make a quick

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decision and install minefields where they are really needed. They can also use the mines in the most rational way. Soviet mines are simple and reliable, which makes it easier for the units to work with them.

In order to lay a minefield quickly and in a technically literate manner, it is necessary to have a good knowledge of the equipment involved, as well as the techniques and methods of creating mined obstacles.

Mine obstacles are capable of sharply slowing down the momentum of the advancing forces, forcing them to move in a direction affording them the least advantage. Mined obstacles can also force the enemy to tighten up combat formations thereby creating a target for a nuclear strike.

US, British and French armies devote considerable attention to the subject of obstacles. It is sufficient to point out that all branches of the military forces are trained in the rules governing the creation of obstacles. The table of equipment for units of the land forces includes antitank and antipersonnel mines that must be installed by the troops themselves.

Mine layers are used for the quick laying of minefields. Helicopters are also used for this purpose. The probable scales on which obstacles would be used in modern warfare are great.

All branches of the military service must know how to clear paths and cross minefields. This is particularly important under the present day conditions when so much significance is attributed to the independent operations of individual units. This gives rise to an important task -- to learn how to detect and cross minefields rapidly and without losses.

Firm knowledge of Soviet and foreign mine armaments, as well as of the techniques and methods of laying and clearing minefields will help to fulfill the established task, i.e. to detect and quickly cross minefields.

The "Manual on the Laying and Clearing of Minefields" describe the designs and operating principles of various mines used in the Soviet Army and in the armies of the main capitalist countries. The manual also covers the fundamentals of laying, reconnoitering and clearing minefields.

In addition to that the manual contains some recommendations with regard to minefield recording, along with a brief description of methods of organizing personnel training. The assimilation of this material will help units to lay and clear minefields on their own in accordance with the requirements of modern warfare.

CHAPTER I

MINES USED IN THE SOVIET ARMY

General Information on Engineer Explosive Items

Specially designed engineer explosive items, including mines — antitank, antipersonnel, beach defense and other mines, are used on a large scale by the Soviet Army for the laying and crossing of mined obstacles, for the purpose of destruction and demolition work.

Mines are used for immobilizing combat and transport vehicles, for the destruction of enemy manpower, and for the destruction of various objectives and other targets.

The main elements of a mine are:

The main charge;
The fuze (firing switch);
Explosive trains
The body.

These elements are amalgamated into a single unit.

The main charge in mines provides the energy for the destruction of an objective. The charge, as a rule, consists of two parts: the main charge and the booster charge. The size of the charge in the mine depends on the purpose for which it is to be used and the degree to which the objective is to be destroyed. The antipersonnel mines, for instance, contain only a few grams of an explosive charge, while the antitank mines may contain several dozen kilograms. Mines installed for the purpose of destroying large objectives contain hundreds of kilograms and perhaps even tons of an explosive charge.

The fuze (firing switch) serves to detonate the explosive charge in the mine.

The fuze usually consists of a trigger-and-primer mechanism and a detonator connected (screwed) to each other.

The trigger-and-primer mechanism, as a rule, is a mechanical and instant action device. It is designed to explode the detonator which explodes the booster charge and the main charge in the mine.

There are two types of detonators. Some of them consist of a primer and a detonating cap joined by a coupling base. Other

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detonators consist only of a detonating cap installed in the coupling base.

The most widespread detonators of the first type are the MD-2 and MD-5m detonators (Figs. 1 and 2) while the most common detonator of the second type is the MD-6 detonator (Fig. 3).

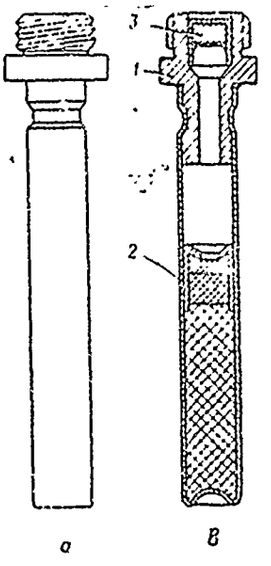

Fig 1. The MD-2 detonator.

Legend: A -- Overall appearance; B -- Cross section; 1 -- Coupling base; 2 -- No. 8A detonating cap; 3 -- Primer KV-11

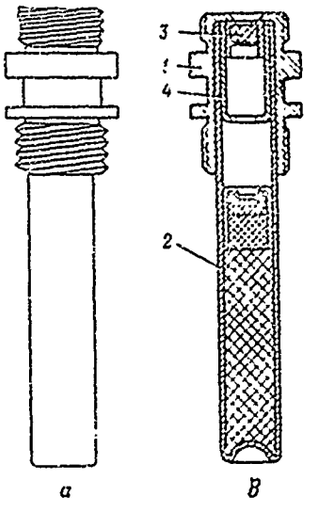

Fig. 2. The MD-5m detonator

Legend: A -- Overall appearance; B -- Cross section; 1 -- Coupling base; 2 -- No. 8A detonator; 3 -- KV-11 primer; 4 -- Firing pin

The firing device serves to transmit the pressure, etc. applied from the outside to the explosive train in the mine. The actuating device includes an actuating lid, the pin, trip wire, control wires, and the like.

The mine box is designed to contain and protect the explosive charge and the fuze from mechanical damage. In the case of antipersonnel mines the mine box is also designed to destroy enemy forces with its fragments.

At the present time mine boxes are made out of metal, wood,

plastics and other materials.

In the pressure action antitank and antipersonnel mines the mine box lid usually serves as the element that transmits pressure to the fuze when a tank track rolls over the mine or a soldier steps on it.

Mines containing an explosive charge but without a fuze are called disarmed mines. They are produced by the plants, stored in warehouses and transported on various kinds of vehicles in that condition.

An armed mine is one that contains a fuze (detonator, electrical detonator).

Mines are divided into antitank, antipersonnel, beach defense mines, antitransport mines, and others.

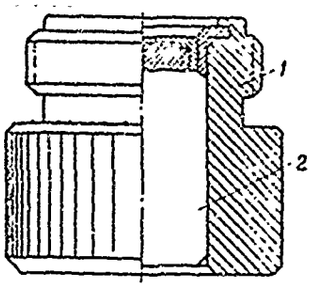

Fig. 3. The MD-6 detonator.

Legend: 1 -- Coupling base;
2 -- Detonating cap.

The design, operating principles and techniques of installing the mines are described below, while specifications of the containers in which these mines come are given in Supplement 2.

Antitank Mines

Antitank mines are designed for mining areas for the purpose of placing enemy tanks, self-propelled artillery weapons and armored personnel carriers out of commission. They are subdivided into tank-stopping and tank-killing mines.

A tank-stopping mine is one that explodes only when the tank track (wheel) runs over it. When exploding it disables only the propulsion part of the vehicle which stops the tank (motor vehicle). The TMD-B, TMD-44 and TM-46 are mines of this type.

Tank-killing mines are those that explode under the tank body and destroy the bottom of the tank or propulsion elements thereby stopping the tank.

The TMD-B and TMD-44 mines. The TMD-B (Fig. 4) and TMD-44 (Fig. 5) antitank, tank-stopping mines consist of a rectangular wooden box with a lid, an explosive charge, and MV-5 mine fuze.

The mine box is made out of 10 mm thick boards that are nailed together. Ammonite briquets or trinitrotoluene are placed in the box. The charge inside the box is secured with straps. Mines with briquets contain booster charges consisting of a prismatic toluene block weighing 160 grams. While booster charges in mines with trinitrotoluene consist of a cylindrical trinitrotoluene block weighing 200 grams. A lid is nailed to the top of the box. The lid

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is partially sawed through in two places along the entire inside surface, so that it would break under the weight of a tank.

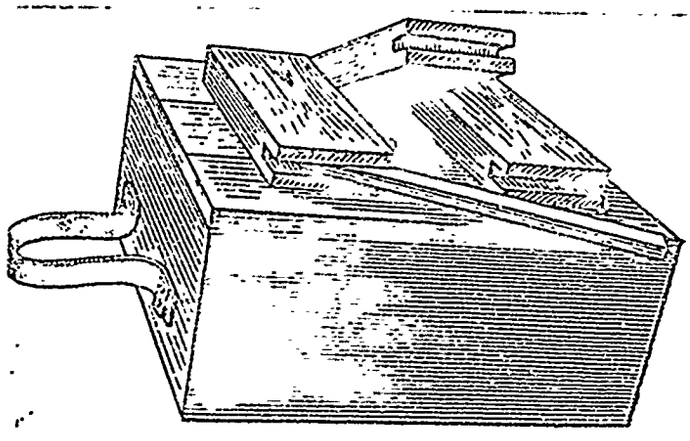

Fig. 4. The TMD-B antitank mine.

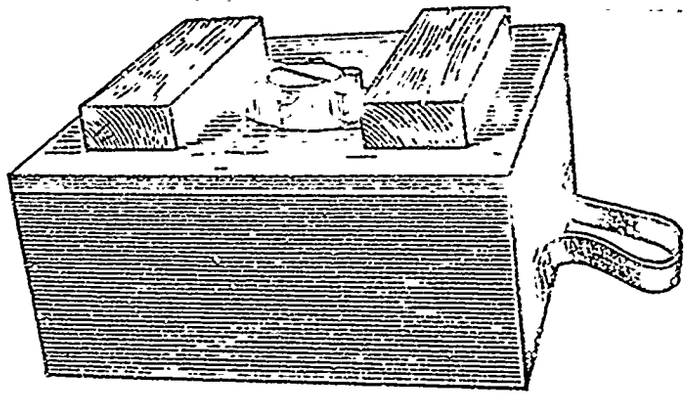

Fig. 5. The TMD-44 antitank mine.

A canvas handle is attached to the side of the box for carrying.

The mine is 320 mm long, 290 mm wide and 160 mm high. The gross weight of the mine with trinitrotoluene is 9.0 kg, and 9.0 kilograms with ammonite briquets. The explosive charge weighs 6.7 kg and 4.8 kg correspondingly. Pressure of 200 to 600 kilograms actuates the mine.

The TMD-B mine has pressure plates on its lid. The middle plate is hinged and serves to cover the opening in the middle of the mine through which the MV-5 fuze is installed in the mine. This lid is secured with a bolt that slides into the slot under the pressure plates.

The TMD-44 mine has two pressure plates. The lid has an opening in the lid between the two plates to permit the installation of the MV-5 fuze. The opening is sealed by a stopper that screws in.

The MV-5 fuze (Fig. 6) consists of a firing mechanism and the MD-2 detonator. The firing mechanisms consist of a fuze cap containing a firing spring and a firing pin which is kept in the raised position by a small ball.

Let us see how the mine works under a tank.

As the tank track or the wheel (of a truck, artillery piece or some other piece of equipment) rolls over the mine, the mine lid cracks along the notches and, as it is crushed, the lid or the stopper presses on the cap of the MV-5 fuze. Compressing the spring the cap moves down until the opening in the housing matches the indentation stamped in the cap. The ball is forced out into the indentation and the freed firing pin, under the pressure exerted by the spring, sets off the primer with its firing point, which explodes the detonating cap, the booster charge and the main charge in the mine.

The TM-46 mine. The antitank tank-stopping TM-46 mine (Fig. 7) consists of a round metal box with an arming dial and a pressure plate. The box contains the explosive charge with a booster charge. There is a fuse well in the center of the lid.

The mine box is stamped metal with an opening for pouring in the explosive charge when arming the mine. The charge is separated from the pressure lid by the plain fuze well. A handle for carrying the mine is attached to the side of the mine box.

The pressure lid has a stepped shape which makes its depression under the tank track a certainty. The mine charge consists of ammonite or trinitrotoluene and a booster charge (a 40 gram cylindrical trinitrotoluene block).

The fuze (Fig. 8) consists of a plug with a casing, the firing mechanism, a safety pin and the MD-6 detonator. The plug comes with the casing, a cover and a diaphragm. The casing contains the firing mechanism. The firing mechanism consists of an adapter, the firing spring, the firing pin and a ball. The MD-6 detonator (Fig. 3) is screwed to the lower end of the adapter. The fuze has a safety pin above the diaphragm. The safety pin is passed through an

opening in the cover of the fuse plug. The pin prevents the tip of the adapter from penetrating through the diaphragm. The fuse with a safety pin is a safety type fuse allowing the safe transportation of the mine in a fully armed condition

How does the TM-46 mine work under the tank track or a truck wheel?

As the tank track or the truck wheel rolls over the top of the mine (the safety pin has been removed from the fuze) the pressure is transmitted by the pressure plate. The cap is forced down tightening the firing pin spring until the notch in the cap allows the ball to roll out, thus releasing the firing pin. The freed firing pin, under the effect of the compressed firing spring, strikes the detonator which sets off the booster charge and then the main charge.

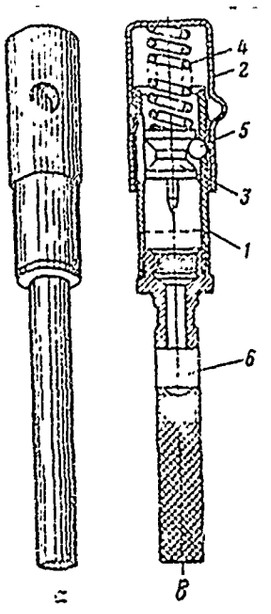

Fig. 6. The MV-5 fuze.

Legend: A -- Overall appearance;
B -- Cross section;
1 -- Housing;
2 -- Cap;
3 -- Firing pin;
4 -- Firing spring;
5 -- Ball;
6 -- MD-2 detonator.

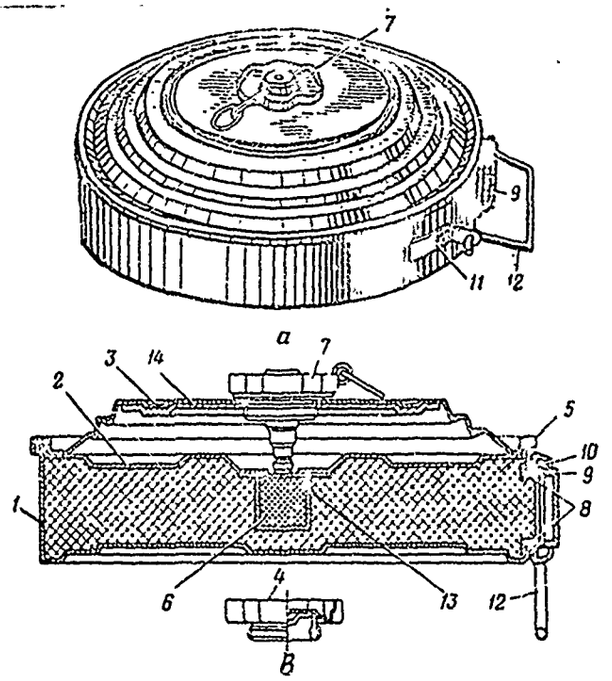

Fig. 7. The TM-46 antitank mine.

Legend: A -- Overall appearance; B -- Cross section; 1 -- Mine box; 2 -- Diaphragm; 3 -- Pressure plate; 4 -- Plug; 5 -- Explosive charge; 6 -- Booster charge; 7 -- Fuze; 8 -- Opening; 9 -- Cap; 10 -- Gasket; 11 -- Lug; 12 -- Handle; 13 -- Fuze well; 14 -- Steel plate.

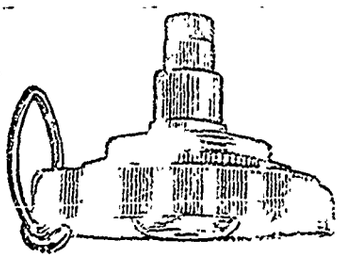

Fig. 8. Fuze for the TM-46 mine.

Preparation of a mine for installation. After having acquainted ourselves with the design of antitank, tank-stopping mines as well as with their principle of operation, let us examine the procedures involved in the preparation and installation of a mine in the area.

In preparing the mine, just as any engineer explosive device, it is always necessary to perform all the operations in a strict sequence.

Following are the operations involved in the installation of the TMD-B and TMD-44 antitank mines.

It is first necessary to pull back the bolt out of the slots under pressure plates, in the case of the TMD-44 mine it is necessary to unscrew the plug.

Using a stick with a sharp tip or a pencil it is then necessary to puncture the paper seal covering the fuze well in the booster block.

The MD-2 detonator is then screwed into the MV-5 fuze.

It is necessary to insert the fuze into the fuze well, carefully, without pressing on the MV-5 fuze cap, until the firing pin rests on the booster block.

After that it is necessary to make certain there is some clearance between the fuze cap and the hinged plate (plug). To do this a ruler is placed on its edge over the opening in the mine cover and passed over the fuse. If the ruler touches the fuze cap it must be replaced and the position of the fuze re-checked. If it is impossible to replace the fuze the mine must not be installed. After checking the clearance the plate is carefully closed on mine TMD-B and secured with the bolt. In the case of the TMD-44 mine the plug is screwed all the way in.

All these operations are carried out directly at the mining site. Preliminary fusing of the mines for installation elsewhere is prohibited.

When preparing the TM-46 mine it is necessary to unscrew the plug on the mine.

Check the presence and correct position of the fuze safety pin (the safety pin must be inserted to the hilt).

Then it is necessary to screw the MD-6 detonator into the fuze.

After that the fuze is screwed into the fuze well until the rubber gasket is fully compressed.

These operations may be carried out ahead of time at the field depot.

The installation of a mine in the ground. The mine is installed in the ground in different positions depending on the time of the year and on the condition of the ground (snow). Mines may be installed directly on the surface of the ground (snow), or they may be installed in holes in the ground -- in mine holes that are camouflaged with dirt or snow after the mine is installed.

When installing a mine in ground covered with plant growth the sod is cut with a shovel to a depth of 5-8 cm forming a 70 x 70 cm square (Fig. 9). The sod is then peeled back in the direction of the enemy. A mine hole is dug in the ground into which the mine is placed. The installed mine is carefully covered over with the sod.

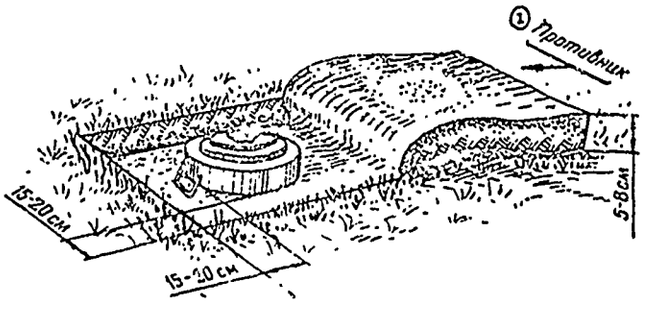

Fig. 9. The installation of an antitank mine in ground covered with plant growth.

Legend: 1 -- Enemy.

In solid ground and well traveled dirt roads the mine, installed in a mine hole, must protrude 2-3 cm above the surface of the ground. The mine is camouflaged on the top with some dirt. In soft ground the mine is installed flush with the surface of the ground and is camouflaged with dirt.

When installing the mine in swampy ground the bottom of the mine hole is lined with boards, branches, poles, and the like, whose dimensions are two to three times greater than those of the base of the mine (Fig. 10).

In the wintertime when the snow is up to 25 cm deep, antitank mines are installed directly on the ground. If the snow is deeper than 25 cm the snow is compacted under the mine, so that after installation the mine could be covered with a camouflage layer of snow from 10 to 15 cm thick (Fig. 11). If the snow is deeper than 60 cm it is necessary to place, boards, poles, branches and the like under the mines in order to create a firm foundation.

In all cases the site of the installed and camouflaged mine must not differ from its surroundings.

The site should not have any signs indicating that mining ... had been under way there.

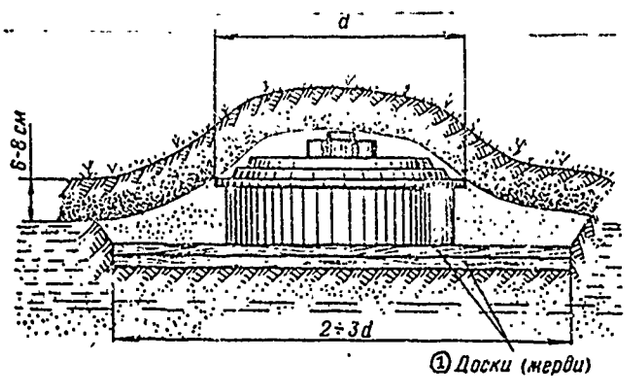

Fig. 10. The installation of an antitank mine in swampy ground.

Legend: 1 -- Boards (poles).

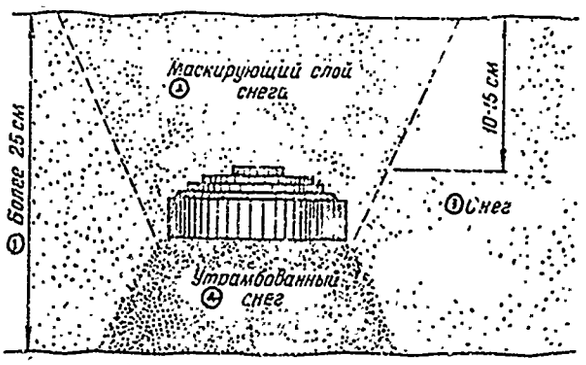

Fig. 11. The installation of an antitank mine in snow deeper than 25 cm.

Legend: 1 -- Over 25 cm; 2 -- Camouflage layer of snow; 3 -- Snow; 4 -- Compacted snow.

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The UITM-60 practice mine

A special UITM-60 practice mine is used for training the troops in the laying and clearing of antitank minefields. Depending on the situation this mine may be used both as a practice mine and an exercise mine.

In the first case the mine simulates the explosion of a real mine under the tank track or truck wheel, producing a sound and a flash effect. In the second case the mine is used for exercises in techniques and methods of mining.

The shape, dimensions, the material of which the box is made, and the force required to set the UITM-60 mine off, are the same as those of the TM-46 antitank mine.

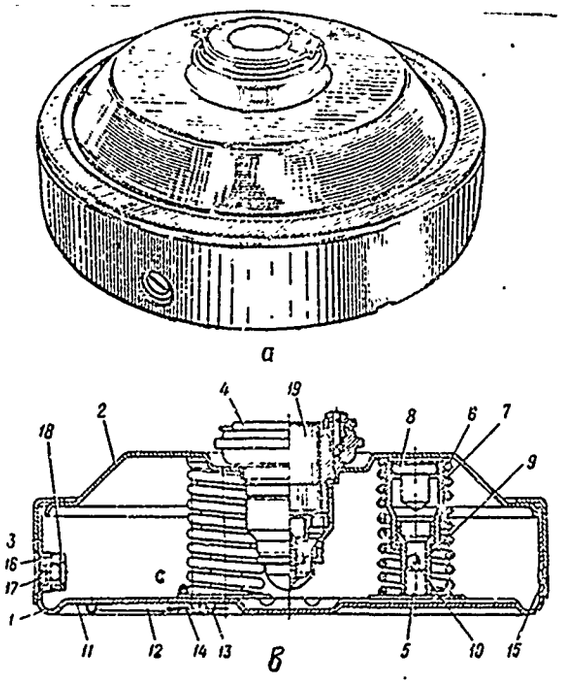

Fig. 12. A UITM-60 practice mine.

Legend: А -- Overall appearance; Б -- Cross section; 1 -- Body; 2 -- Pressure plate; 3 -- Circular rim; 4 -- Fuze; 5 -- Stand; 6 -- Spring; 7 -- Sleeve; 8 -- End cap; 9 -- Core; 10 -- Ball; 11 -- Cover plate; 12 -- Collapsible handle; 13 -- Catch; 14 -- Splint; 15 -- Stopper; 16 -- Sleeve; 17 -- Plug; 18 -- Safety nut; 19 -- Signal flare.

The UITM-60 mine (Fig. 12) consists of a box, a lid, circular detachable rim and a fuse. The mine also includes signal flares and devices for disassembling it.

The mine box is made out of sheet steel. Three stands with springs and ball arresters are secured to the bottom inside the box. Three stoppers are secured to the side wall of the box. The circular detachable rim serves to secure the mine box to the lid. It has three L-shaped slots into which the stoppers are fitted when the mine is assembled. The lid, serving as the actuating device of the mine, rests on three ball arrester sleeves and is secured to the mine box by the circular rim. There is a threaded fuze hole in the center of the lid.

The practice UIMV-60 fuze (Fig. 13) consists of a casing, firing mechanism housing and contains a signal flare. The fuze casing is open on both ends serving as the breech chamber for the signal flare. The lower part of the casing contains a large diameter thread for screwing in the fuze into the mine lid, and a smaller diameter thread for screwing in the firing mechanism container.

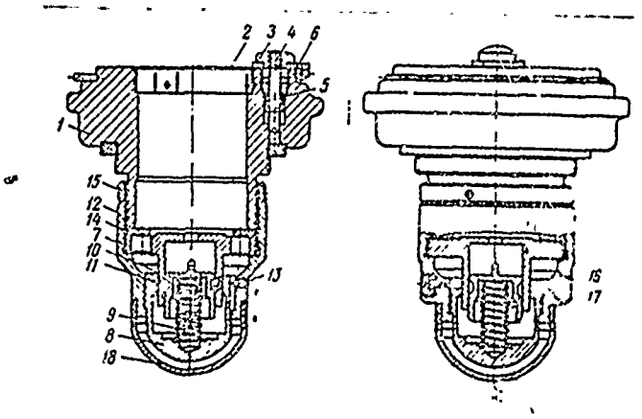

Fig. 13. UIMV-60 Fuze for the practice mine.

Legend: 1 -- Casing; 2 -- Cap; 3 -- Button; 4 -- Coupling rod; 5 -- Spring; 6 -- Safety pin; 7 -- Adapter; 8 -- Tip; 9 -- Spring; 10 -- Hammer pin; 11 -- Ball; 12 -- Housing; 13 -- Joint pin; 14 -- Padding; 15 -- Lock nut; 16 -- Shearable pins; 17 -- End cap; 18 -- Safety cap.

The signal flare (Fig. 14) consists of a pasteboard cartridge and a brass bottom containing a percussion flash igniter, an inside aluminum cartridge with a delayed action flash igniter, an ejection charge consisting of black powder, and the light signal block.

The mine has a diameter of 32 cm, a height of 12.5 cm, and weighs 8.7 kg. The pressure required to set off the mine is 200-600 kg.

The armed UITM-60 mine is installed only in a mine hole in the ground, just as the TM-46 mine. In order to prevent damage to it the installation of the UITM-60 mine on the surface of the ground is not recommended. The mine may be used a number of times to simulate an explosion under the tank tracks. To re-use it, however, it is necessary to re-arm the mine using a special device (Fig. 15), designed for the disassembly and assembly of this mine.

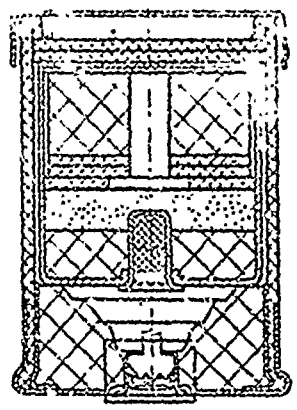

Fig. 14. Signal flare.

The mine is armed with the UIMV-60 fuze in the following sequence:

The plug or the unarmed fuze are screwed out of the lid;

The lock nut is undone with a wrench on the fuze casing after which the firing mechanism is screwed to the housing;

The cardboard lining is removed from the firing mechanism housing;

The signal flare is inserted into the fuze casing as far as it will go;

The firing mechanism housing is screwed to the fuze casing and secured with a lock nut using a wrench;

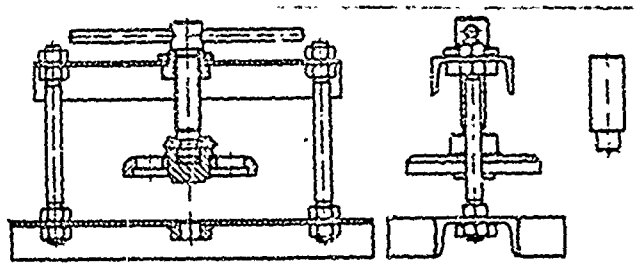

Fig. 15. Device for disassembly and assembly of the mine.

The safety cap, covering the tip of the fuze is screwed on;
The fuze is then screwed inside the mine.
In order to disassemble and re-arm the mine it is necessary to:

The fuze is screwed out of the mine;

The safety cap is screwed on the fuze;

The mine is disassembled with the aid of the special device, the circular rim and the lid are removed and, if it is necessary, they should be wiped dry;

The lock nut on the fuze casing is undone with the aid of a wrench and the firing mechanism housing is removed;

The spent cartridge is removed from the breech chamber which is then cleaned;

The two end caps are removed from the housing and the sheared pins are shaken out of it;

The firing mechanism is cocked by pushing back the hammer pin until the two balls snap into the recess (click is heard), the spare shearable pins are inserted and the end caps are screwed in;

A new signal flare is inserted into the breech chamber;

The firing mechanism housing is screwed on the fuze casing as tightly as possible after which it is secured with a lock nut;

The fuze is then screwed into the lid of the mine.

How does the antitank practice mine operate under the tank track (wheel of a vehicle)?

As the tank track rolls over the mine, the lid, compressing the springs of the ball arresters, is pushed down together with the fuze. When the tip of the fuze reaches the bottom its movement is stopped, but the firing mechanism housing continues to descend. The safety pins are sheared off, the balls roll out, the freed striking pin, under pressure from the spring, strikes the primer of the signal flare and ignites it. The delay train is ignited by the flash igniter, which, in turn, ignites the ejection charge in three to four seconds. The signal flare is ignited as the ejection charge is set off. The signal flare is ejected from the cartridge, penetrates the camouflage layer of dirt and shoots up to a height of 25-40 meters, where it bursts into four lights: two red and two green.

Antipersonnel Mines

Antipersonnel mines are designed for mining the terrain for the purpose of destroying enemy manpower. These mines may be installed separately to form entire minefields, or in combination with antitank mines both within an antitank minefield and in front of it.

Depending on the damaging action the antipersonnel mines are subdivided into blast mines and fragmentation mines. The former, as a rule, are pressure action mines, while the latter are pull action mines.

Pressure action blast mines include the PMD-6 mine, while the fragmentation pull action mines include the POMZ-2 and the POMZ-2m mines.

The PMD-6 antipersonnel pressure action mine (Fig. 16) consists of a rectangular wooden box with a lid hinged to the box. The

interior of the box contains a 200 gram trinitrotoluene block. The front wall of the box contains a circular opening for the MUV or MUV-2 fuze. The front edge of the lid contains a rectangular opening through which the fuze protrudes when the lid is closed.

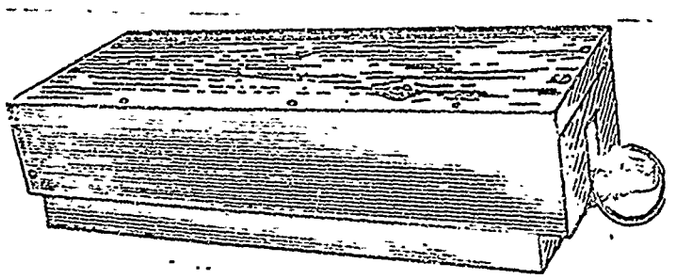

Fig. 16. The PMD-6 anti-personnel mine.

In order to increase the amount of pressure required to set off the mine a metal plate is attached to the inside of the lid. When the lid is closed the plates rests on the trinitrotoluene block and keeps the lid in a raised position. In the firing position the front edge of the lid rests with its bottom edge on the shoulders of a T-shaped fuze safety pin.

The mine is 190-200 mm long, 90 mm wide, and 45-50 mm high. The mine weighs a total of 450-500 grams. The force necessary to actuate the mine without the plate is 1-2 kg, while with a plate pressure of up to 25 kg is needed.

The MUV fuze (Fig. 17) consists of a cylindrical metal or plastic body, a striker, a striker spring, A T- or a P-shaped safety pin and the MD-2 (MD-5) detonator.

In the firing position the spring is compressed, the pin passes through the lower opening in the striker and holds it in a cocked position.

The MUV-2 fuze (Fig. 18) differs from the MUV fuze only by its time safety lock. The safety lock consists of a lamellate metal element which keeps the striker in a cocked position for no less than 2.5 minutes after the safety pin is removed. The safety lock ensures the safe installation of the mine.

After the installation of the fuze inside the mine and the safety pin is removed, the cutting wire, under pressure exerted by the spring, slices through the metal element and moves forward until it rests on the safety pin thereby reverting to the firing position.

Under the effect of pressure, the lid is pushed down and squeezes the safety pin out of the MUV *MUV-2) fuze. As the pin is removed the striker is freed and, under the pressure of the

spring, strikes the percussion cap which activates the detonator which sets off the trinitrotoluene block.

Sequence of Operations to be Followed in Preparing and Installing the Mine in the Ground

It is possible to prepare the PMD-6 mines for installation ahead of time (before the mining operations begin) at the field depot.

In preparing the mines it is necessary to:

Insert the 200 gram trinitrotoluene block into the mine box, so that the well for the explosive train would face the opening in the mine box (if the block has already been inserted in the mine box it is necessary to check its position);

Check the two safety pins in the MUV (MUV-2) fuze and install the T-shaped pins in them;

In the case of an MUV-2 fuze remove the rubber cap and check the condition of the time safety lock (condition of the cutting wire and the presence of the metal element), and replace the cap;

Check the presence of safety pins in the fuzes;

Prepare a metal safety pin 10-12 cm long with a 6-10 meter piece of strong twine (twisted twine is best) or a piece of thin wire attached to it for every combat engineer who is to install the mines.

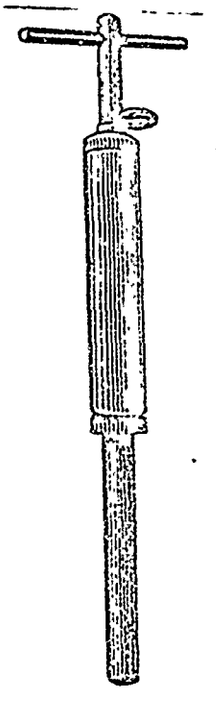

Fig. 17. The MUV fuze.

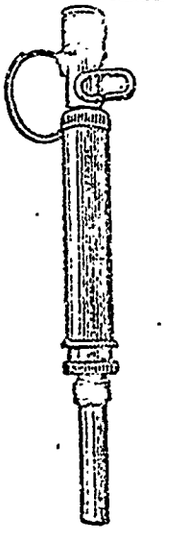

Fig. 18. The MUV-2 fuze.

The mines are installed in the following sequence:

Dig a mine hole according to the size of the mine, so that the installed mine would protrude 1-2 cm above the surface of the ground;

Place the mine with its lid open into the mine hold, join (couple) the MUV-2 (MUV) fuze casing with the MD-s (MD-5) detonator;

Insert the fuze into the opening in the front wall of the mine box, so that the detonator would enter the detonator hosing in the trinitrotoluene block. The shoulders of the T-shaped fuze pin must touch the side of the mine box. In the installation of the PMD-6 mine with the MUV fuze, it is necessary to place the installation safety pin, without closing the lid, alongside the fuze (Fig. 19)

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resting on the trinitrotoluene block and the front edge of the mine box;

After that the mine lid should be closed carefully so that the installation pin would be in the notch in the front edge of the lid (the twine attached to the pin must be unwound);

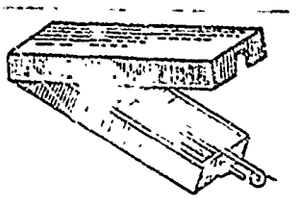

Fig. 19. The PMD-6 antipersonnel mine with an installation safety pin.

The mine then must be camouflaged to match the surroundings (grass, leaves or dirt);

The installation pin is pulled out of the mine by the twine from a distance of five to ten meters.

When installing the PMD-6 mine with a MUV-2 fuze, it is necessary to remove the safety pin from the MUV-2 fuze while holding the mine box. After which the mine lid is carefully closed and the mine camouflaged.

The POMZ-2 and POMZ-2m mines. The POMZ-2 and the POMZ-2m mines (Fig. 20) are identical in appearance. They consist of a cylindrical metal case with an open bottom through which a 75 gram trinitrotoluene block is inserted (the charge) along with a small wooden installation peg. On the top the POMZ-2 mine also has an opening for the insertion, or in the case of the POMZ-2m mine, for the screwing in of the MD-5m detonator of the MUV-2 (MUV) fuze with a P-shaped safety pin. Therefore the POMZ-2 mines may be used with fuzes with MD-2 and MD-5m detonators, while the POMZ-2m mines can be used only with the MS-5m detonator.

The mine is 60 mm in diameter, 107-130 mm in height. The total weight of the mine is 1.75-2.3 kg, while the mine case weighs 1.2-1.5 kg.

For a better and more even fragmentation the outside surface of the mine case is notched.

The mine set includes two wooden pegs and a trip wire with a snap hook. The mine is stuck on one of the pegs, called the installation peg. One end of the trip wire is attached to the other peg, while the other end of the wire is attached to the mine safety pin with the snap hook (Fig. 21).

The operating principle of the mine is as follows:

If the trip wire is either stepped on or tripped with the foot, the safety pin is pulled out which activates the fuze and explodes the charge in the mine.

During the explosion the mine case is shattered into small fragments which are hurled out in radial directions destroying enemy troops within a radius of four meters.

Fig. 20. The POMZ-2m antipersonnel mine.

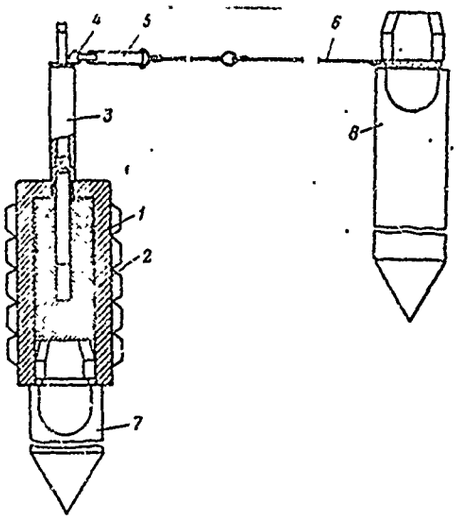

Fig. 21. Installation diagram for the POMZ-2m antipersonnel mine.

Legend: 1 -- Case; 2 -- Explosive charge; 3 -- Fuze; 4 -- Safety pin; 5 -- Snap hook; 6 -- Wire; 7 -- Installation peg; 8 -- Peg.

Sequence of operations involved in the preparation of the mine for installation. When installing the POMZ-2 (POMZ-2m) mine with only one trip wire branch it is necessary to:

Drive the trip wire peg into the ground so that it protrudes 10-15 cm above the surface of the ground;

Secure the end of the trip wire to the peg;

Unwind the trip wire in the direction of the mine;

Drive the installation peg into the ground where the mine is to be positioned so that it would protrude 4-6 cm above the ground;

Insert the trinitrotoluene block into the mine case so that the fuze well faces the upper (smaller) opening;

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Stick the mine body on the installation peg in the ground until it touches the trinitrotoluene block;

Secure the snap hook to the trip wire;

Install the MUV (MUV-2) fuze through the upper opening of the POMZ-2 mine, (screw in the fuze if the MD-5m detonator is used in the POMZ-2m mine);

Neatly attach the snap hook to the ring of the safety pin so that the wire has a little slack, while the safety pin is firmly inserted in the striker mechanism;

After making certain that the safety pin is inserted firmly, pull out the safety pin of the MUV-2 fuze or the safety pin from the MUV fuze.

When installing the POMZ-2 (POMZ-2m) mine with two trip wire brances (Fig. 22) it is necessary to:

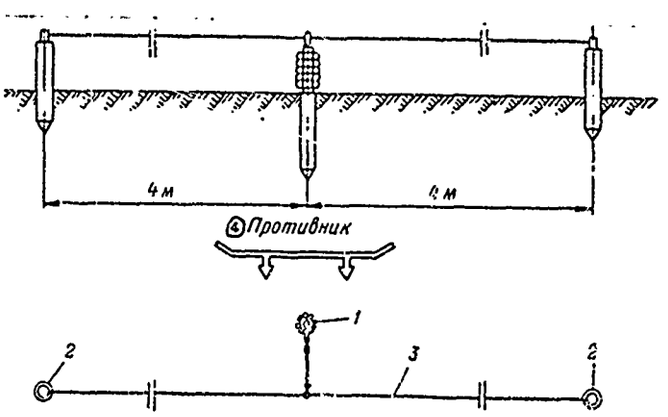

Fig. 22. Diagrams showing the installation of the POMZ-2m (POMZ-2) antipersonnel mine with two trip wire brances.

Legend: 1 -- Mine; 2 -- Peg; 3 -- Trip wire; 4 -- Enemy.

Drive two trip wire pegs into the ground at a distance of about eight meters from each other;

Attach the wire loop with the snap hook to the trip wire;

Tie the trip wire to the pegs driven into the ground so that it would be tightly stretched;

Drive the installation peg into the ground at a point in the middle of the trip wire in the direction of the enemy at a distance from the trip wire equal to the length of the wire loop with the snap hook;

Subsequent operations are the same as in the installation of a mine with a single trip wire branch.

Facilities for Mechanizing Mining Operations

The installation of antitank mines in the ground with camouflage demands considerable physical effort on behalf of the combat engineers and takes up a lot of time. It is sufficient to point out that the installation of a single antitank mine requires around ten minutes.

The labor consuming processes involved in mining operations are: the transportation of the mines to the minefield, the distribution of the mines among the different rows, the digging of mine holes in the ground, and the installation and camouflage of the mines.

In order to accelerate and simplify the mining process the Soviet Army uses mechanized facilities for the installation of antitank mines.

The PMR-2 trailer type mine layer. This mine layer is designed for rapid installation (laying) of antitank mines on the surface of the ground (snow) during minefield laying.

The mine layer (Fig. 23) is a two-wheel trailer consisting of an undercarriage, two guiding and two lowering chutes, two delivery mechanisms, a spacing control box, and a chain transmission.

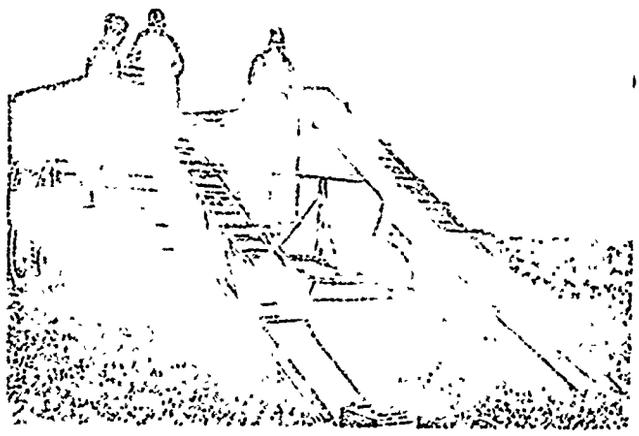

Fig. 23. The PMR-2 trailer type mine layer.

Mechanisms of the mine layer are installed on a frame welded out of channel bars, along with the shaft with a lug for attachment to a hook on the towing vehicle. The front part of the frame contains

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the guiding chutes, while the rear part of the frame contains the spacing control box.

The undercarriage of the mine layer consists of the axle, two automobile tires, and springs. A drive mechanism is secured to the axle near the right wheel. The guiding chutes consist of welded trusses made of angle iron serving to guide the mines as they move from the truck to the distributing mechanism.

In its upper part the chute has a wide mouth through which the mines are loaded. Double roller conveyors extend along the entire length of the chutes allowing the mines to slide down under the effect of their own weight to the distributing mechanisms.

The arresting plates are situated on the sides of the chute and when the TM-46 mines are being laid they are installed in the lower position. The plates are moved to the top of the chutes when the TMD-44 and TMD-B mines are laid.

A lowering chute is installed at the end of the guiding chute.

The distributing mechanism is designed to pass the mines through from the guiding to lowering chute at two or four meter intervals traveled by the mine layer.

The spacing control box permits a change in mine spacing.

The carriage may be moved into one of three positions with the aid of a handle. The three positions are marked on the top of the box with figures 2, 0, 4. The middle position (0) is neutral, while the other two positions are operating positions and correspond to the spacing of the mines -- two or four meters.

The chain transmission consists of the drive mechanism sprocket and the driven sprocket.

The mine layer is coupled with the rear hook on the truck (armored personnel carrier) loaded with mines, and is towed by the latter. The mines are placed in the chutes by combat engineers who are in the back of the truck. Under the pull of gravity the mines slide down along the rollers. The first mine is stopped by the upper catches. As the truck moves, the right wheel of the mine layer rotates, which operates the distributing mechanisms through the drive chain, the distributing box, the Cardan shaft and the rollers. The distributing mechanisms will alternately raise and lower the catches. As soon as the lower catches are lowered the first mine will slide to the ground.

During further operation of the distributing mechanisms the upper and lower catches will be raised and lowered alternately after a certain number of revolutions of the minelayer's wheel, letting one mine at a time slide to the ground. The mines do not come out of both of the chutes simultaneously. They are lowered alternately(through one of the chutes and then through the other one) and are distributed on the ground in a checkered pattern.

Technical Specifications of the PMR-2 Mine Layer

Type of mines laid by the mine layer....Armed TM-46 mines with the MVM fuze. Incompletely armed TM-46, TMD-44 and TMD-B mines.

Mine spacing .....Two or four meters.

Number of rows mined.....One or two (depending on the number of chutes used).

Distance between chutes (rows of mines).....Two meters

Speed of mine layer when mining.....Up to 5 km/hr.

Time required to lay 200 mines:

Mines spaced at 2 meters (using two chutes).....5-8 minutes

Mines spaced at 4 meters (using one chute).....10-15 minutes.

Preparation of the mine layer for operation. The truck (artillery tractor armored personnel carrier) is loaded with antitank mines. The vehicle may carry from 100 to 400 mines depending on the type and the carrying capacity of the vehicle.

Antitank mines in their wooden boxes are loaded on the vehicle without special packing, on the side with the handles up. The mines with metal cases are loaded in wooden crates.

In order to facilitate work during mining the rear part of the truck is not loaded with mines, i.e. some room is left for two combat engineers who load the mines into the chutes when the mine layer is operating.

The mine layer is coupled to the rear hook on the truck through the lug. The coupling is then secured with a pin.

The length of the connecting rod is regulated so that the ends of the chutes would not brush against the sides of the truck during turns (the distance between the ends of chutes and the truck frame must be no less than 25 cm).

The drive must be engaged, while the handle of the reducer handle must be opposite the zero notch. In this position the mine layer may be transported to the site of the minefield.

On arrival the lowering chutes are attached, and the personnel loads mines into the guiding chutes. The mines are lowered into the chutes with the handles towards the back. Two men control the mines sliding down the chutes to prevent jarring. The handle sets the mine spacing, after which an order is issued to move out and the mines start sliding down to the ground.

CHAPTER II

THE LAYING AND UTILIZATION OF MINEFIELDS

General Features

Minefields are used in all types of combat operations by the military forces.

In an attack minefields are installed:

When repulsing enemy counterattacks;

For the purpose of consolidating occupied positions;

For the purpose of obstructing the retreat of an enemy under pursuit.

When repulsing counterattacks the mines must be installed along the established directions of enemy action, literally along the firing tracks of his tanks. Such minefields will constitute a surprise to the enemy, and, therefore, will be more effective, while at the same time least constricting for the friendly forces. Such minefields will most often be short antitank minefields, whose position must be closely tied in with the antitank fire system, the concept of the battle and the natural obstacles existing on the terrain. Technical facilities such as mine layers and trucks must be used for the rapid installation of minefields.

The utilization of minefields helps a limited force (antitank, tank or other reserve force) to repulse enemy counterattacks without the diversion of troops and equipment from the main assault forces.

The last circumstance is very important in the offensive battle. The purpose of the counterattack is to check the advance or to decrease its momentum, to weaken the attacking forces by engaging them in battle, thereby giving the retreating forces or the newly arrived reserves to consolidate new positions. To repulse an enemy counterattack with small forces means to deprive him of this possibility, which means that the friendly forces will advance at a rapid tempo.

Information regarding newly installed minefields is immediately

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relayed to the friendly forces. After repulsing the counterattack security measures must be taken to see off the minefields. If the situation allows the minefields are cleared.

The consolidation of occupied positions is of greater significance under the present day conditions than it was in the past war. This is explained by the fact that nuclear strikes permit a rapid change in the relationship of forces in a given sector of the front. Consequently changes in the situation, right up to a change in the type of combat operations (a shift from an attack to forced defense), may occur much more frequently than in the past. Therefore the consolidation of occupied positions becomes a very important task.

Advantageous, natural areas are selected for consolidation where effective obstacles may be installed within the shortest period of time and with a minimum expenditure of manpower and equipment. Antitank and antipersonnel minefields are installed around such positions. If necessary bridges, roads and other highway structures are prepared for demolition.

In case of a sharp change in the situation the consolidated and prepared (in the engineering sense) position will permit the delay of a superior enemy force.

The retreating enemy will attempt by all possible means to disengage from the pursuit force to gain time for the purpose of organizing a new defense position. Therefore, in order to block the retreating enemy, his retreat route is mined, roads are partially destroyed and various highway structures are damaged. For this purpose small detachments are landed behind enemy lines which under the cover of darkness install mines along the roads, at points where rivers or streams may be forded, and also destroy small bridges.

Mining and demolition operations are carried out on a scale dictated by the situation that develops. It is necessary to remember that extensive demolition, even though it may delay the retreating enemy, could later interfere with the operations of the pursuing troops.

Obstacles are used on the largest scale in defensive operations. These obstacles consist of antipersonnel and antitank mines, as well as of clusters of mines or single mines on roads, in bottlenecks, along paths and in populated points.

The distribution of obstacles on the terrain is tied in with the concept of the battle, the antitank fire system and the natural obstacles. The obstacles are installed with the highest density along tank threatened directions of the anticipated enemy attack.

Mined obstacles are used to cover positions and areas occupied by the forces, as well as the areas between them, along with artillery fire positions, control points, and water barriers at points convenient for crossing.

Obstacles and demolition are prepared along the entire depth of the defenses along directions from which the main enemy attack is anticipated. These obstacles are then expanded and developed in the

course of the battle in accordance with the developing situation.

In making decisions concerning defense the sites for minefields are first plotted on a map and then determined in greater detail by means of reconnaissance. Decisions are then also made concerning the types of minefields to be layed ahead of time, as well as in the course of the battle. The interaction of combat engineers with the units defending the given area is also specified.

In the course of the battle obstacles that are installed are primarily minefields which are laid using mine layers and motor vehicles on a large scale.

Adequate manpower and equipment is allocated for mining operations in the course of the battle. The proposed boundaries of the minefields are marked off with boundary markers, minefield references are compiled, and convenient minefield approach and exit routes are determined.

Obstacles may be used in counterattacks launched by our forces. Obstacles are installed for the purpose of covering the flanks of counterattacking forces, for the consolidation of lines reached in the course of the counterattack.

As a result of nuclear strikes gaps will occur in the system of obstacles as well as in individual minefields, which the enemy will attempt to use for rapid penetration of the obstacles. The gaps must be immediately filled. The gaps must be filled in the following manner. The first to go into operation is an engineering reconnaissance patrol whose task it is to determine the size of the gaps and find safe approach routes to it (some of the mines may be scattered by the blast). After that a subunit with mechanized mining equipment is sent out for the purpose of installing new obstacles.

Mined obstacles may be used both independently and in combination with other types of obstacles. They are frequently used to reinforce natural obstacles.

Mined obstacles are created in the form of minefields, clusters of mines (3-5 mines) or single mines.

The minefield is a fundamental type of obstacle. A minefield is understood to be a sector of the terrain in which mines have been installed in a certain order.

Minefields are characterized by the following basic indices:

Minefield density, or in other words -- the number of mines installed per kilometer of minefield;

Depth;

Extension (length) along the front.

What is the recommended minefield density at the present time and what is used to determine the indicated characteristics of a minefield?

Minefield density is determined on the basis of the destruction probability of enemy tanks on the minefield. Practical and theoretical estimates indicate that the most effective minefield density varies from 750 to 1,000 tank stopping mines per kilometer

of the minefield front.

With a minefield density of 750 mines per kilometer of minefield the destruction probability of enemy tanks may amount to an average of 70%, i.e. out of every 10 enemy tanks attempting to cross the minefield, seven will be destroyed by mines and three tanks will cross the minefield providing they are not destroyed by antitank artillery fire.

The depth of the minefield depends on the number of rows of mines and the distance between them. Antitank minefields are, as a rule, installed in three-four rows (Fig. 24). The minimum distance between rows is 8-10 meters, and the maximum distance is 30-40 meters. The overall depth of the minefield may fluctuate between 20 and 120 meters, and sometimes more.

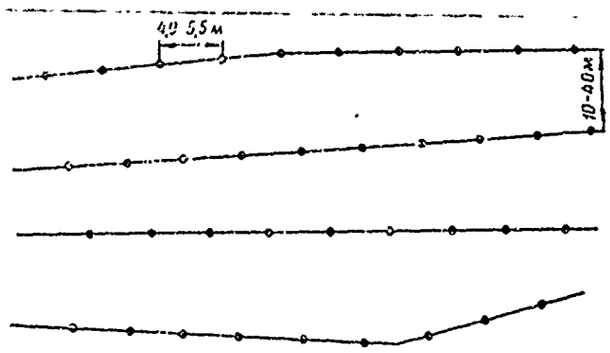

Fig. 24. Diagram of an antitank minefield.

The extension of the minefield depends on the number of mines in a row and the distance between them. Antitank mines are installed at intervals of 4.0-5.5 meters.

Antipersonnel minefields (Fig. 25) consisting of pressure action mines may have a density of 2,000 mines per kilometer of minefield. 200-400 pull action mines are installed per kilometer.

The depth of such minefields fluctuates between 10 and 40 meters, while the extension of the minefield depends on the mission at hand and the area that must be mined.

Pressure action antipersonnel mines are installed every one to two meters, the distance between pull action mines is five or more meters depending on the mine fragmentation radius.

In order to make it difficult for the enemy to find detours it is feasible to install minefields so that they are flanked by natural obstacles (ravines, swamps and the like).

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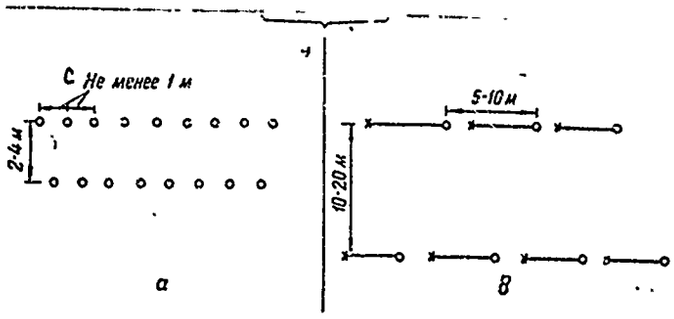

Fig. 25. Diagrams of antipersonnel minefields.

Legend: A -- Pressure action mines; B -- Pull action mines;
C -- Not less than 1 meter.

Antitank and antipersonnel minefields, covering positions occupied by the troops, must be installed no closer than 10 meters to the trenches of friendly troops.

The installation of mined obstacles is carried out on orders of the senior commander. In assigning a mining mission the unit commander must indicate:

The reference points;
Information on the enemy;
Boundaries of the minefield;
Depth, extension and number of rows as well as the space between mines;
Means of installing the mines;
The starting and termination time for the mining operation.

When installing minefields in the forward area the personnel engaged in the mining operation are given fire cover.

Methods of Installing Antitank Minefields

The selection of a certain method for installing minefields depends on the site and the time of their installation, the nature of the terrain to be mined, the combat situation as well as on a number of other factors.

There are several methods of installing minefields:
By a detail;
Along a mine laying cord;
With the use of mine layers;
From motor vehicles.

Installation of mines by a detail. The installation of mines by a detail is carried out on terrain not under enemy surveillance. When a detail is used to install the mines each soldier may carry and install two to four mines. The number of mines is determined depending on the number of rows in the minefield, the distance to the mine dump, the degree of training and the physical condition of the personnel. When installing a triple row minefield, for instance, each soldier must carry three mines, when a minefield of four rows is installed it is possible to carry two or four mines on each trip.

By way of an example let us examine the method of installing a triple row minefield (Fig. 26). The unit commander determines the

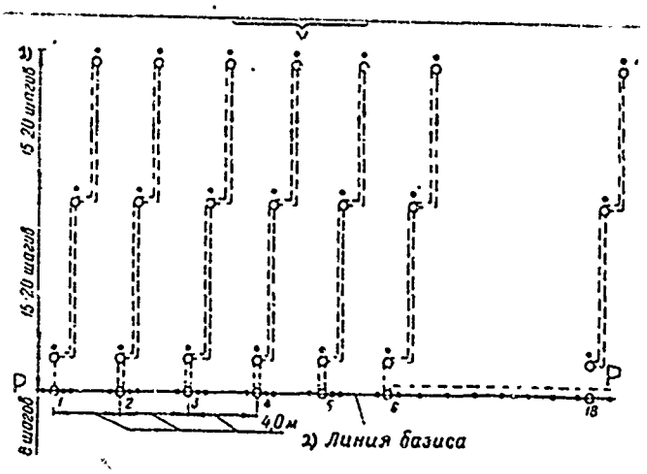

Fig. 26. Diagram showing the installation of a triple row minefield by a detail.

Legend: 1 --Paces; 2 -- Base line.

boundaries of the minefield on the terrain and designates the base line with stakes. On level terrain it is sufficient to install two stakes -- at the beginning and end of the minefield. A mine dump is prepared in a sheltered area (ravine, deep shell hole, and the like). The site for the dump should be picked close to the minefield, no farther than 50-100 meters in order to decrease the time required for delivery of mines to the installation site.

As already mentioned above each soldier carries three mines from the dump to the minefield site. At the minefield site the subunit falls in forming a single rank formation with 506 paces (4.0 meters) between the men, along the line between the markers.

After that, following the command "Five (ten) paces forward march!" The subunit moves up the indicated distance and on the command "Place one mine," each man places a mine on the ground. After that the commands: "Two paces to the right, march!" and "Fifteen paces forward march!" are given (the distances given here are just an example). The subunit moves up 15 paces and on the command "Place second mine," executes it. After that the subunit moves two paces to the right and again moves up 15-20 paces. The third mine is placed on the ground and on the command "Install mines," all the soldiers install and camouflage the last row (third) of mines. After the installation of these mines on an order from the commander the subunit installs and camouflages the previously placed second and first rows of mines. After completing the installation and camouflage of the mines the subunit leaves the minefield on command and proceeds to the dump for mines for the next trip. The right (left) boundary of the rows of installed mines is designated with markers which are removed on the next trip.

When a detail is used for mining operations at night the organization of work is the same, except that each soldier carries all the mines to the farthest point where the first mine is installed, after which he proceeds to the next installation points with the remaining mines. It is not recommended to move away from the minefield in the direction of the enemy so as not to make unnecessary tracks.

The procedures involved in the installation of a four row minefield, in which case each soldier carries four mines, is no different from the procedures described above.

When installing a shallow minefield in direct proximity to the first trench of the friendly troops the following procedure is recommended. During daylight hours the site of the minefield is determined, particularly its forward and rear boundaries. A stock of mines is created in the trench (40 mines per 50 meters of minefield). Reference points are noted on the terrain -- branches, bushes, shell holes and the like.

Before initiating mining operations the subunit commander posts observers and organizes fire cover. The personnel picked for the mining operation are divided into three-man crews. In order to accelerate the work it is necessary to lay the mines out on the elbow rest of the trench at intervals of two paces.

At the appointed time the subunit commander moves the crews to one of the flanks of the proposed minefield. Every crew member takes one mine and crawls out of the trench. When the first crew member reaches a point in line with the marker designating the rear row of mines, he stops, digs a mine hole, installs and camouflages the mine. At that time the second and third crew members continue moving forward. In about 8-10 meters the second crew member stops while the third crew member continues on for another 15-20 meters. These crew members also stop, install and camouflage the mines at the indicated points. The soldiers return to the trench in a

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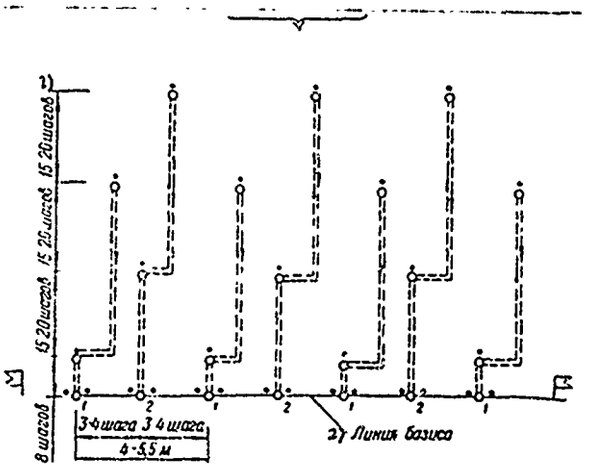

Fig. 27. Diagram showing the installation of a four row minefield by a detail.

Legend: 1 -- Paces; 2 -- Base line.

reverse order -- the third crew member returns first, followed by the second crew member (when the third crew member reaches a position in line with him) and then the first crew member. It is recommended to note some orientation feature against the night sky while still in the rear area (a tall tree, ruins, etc.). This will help the crew members to orient themselves better on returning to the trench. The subunit commander posts the crew members by the next three mines and gives the command for a second trip.

For a more even distribution of the load the first and third crew members switch positions after each trip, since the third crew member has to crawl 15-20 meters farther than the first crew member.

Deep in the strong point, when there is no enemy fire and the visibility is poor, the soldiers may move in a stooped position. This speeds up the mining operation considerably.

Installation of mines with the mine laying cord. A mine laying cord is used to install antitank and antipersonnel minefields in the forward area. The use of a mine laying cord facilitates the installation of mines at certain distances along the front and in depth. At the same time ensuring safe movement under night time conditions.

A mine laying cord consists of a cord (Fig. 28) 60 meters in length with rings on the end. Snaps are attached to the cord at intervals of one meter to be used for securing tags or rings. These tags or rings are used to designate the points near which the mines must be installed. The cord is wound up on a reel and carried in a

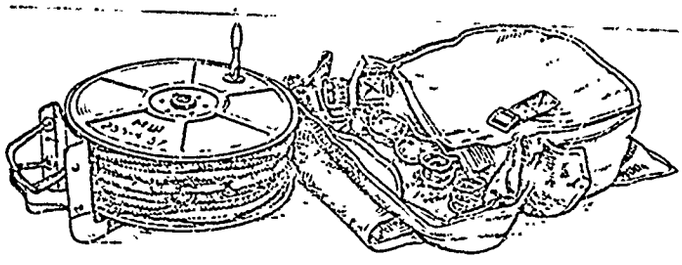

Fig. 28. A mine laying cord.

canvas bag. The subunit commander issues orders to prepare the mine laying cords ahead of time in accordance with the established minefield plan, i.e. the rings must be attached to the appropriate snaps along the cord.

The personnel picked for mining duty are formed into two-man details. Each detail works with one mine laying cord. The way in which the mines are installed by the detail is shown in Fig. 29.

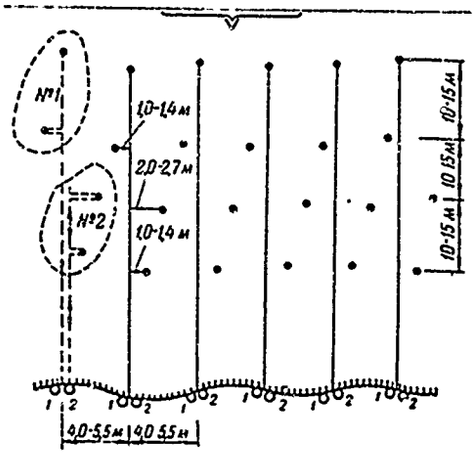

Fig. 29. Diagram showing the installation of antitank mines along a mine laying cord.

In the trench the subunit commander positions the details by the previously installed markers (pegs) 5.5 meters from each other. The first members of the details, tying the end of the cord to their belts, take with them two armed antitank mines with them along with an entrenching tool, and a peg to pin the cord to the ground. On

orders from the subunit commander the first members of the details crawl out of the trench. They move by crawling or short sprints, keeping a bearing on the first member of the first detail who orients himself by the terrain features or a compass. When the first members of the details reach the end of the cord, they untie it from their belts and secure it to the ground with pegs so that it will be easy to pull the cord out later.

The first mine is installed at the end of the cord. Then the first members of the details take the second mine in their right hand and, holding on to the cord with their left hand, crawl along the cord in the direction of their trench. Feeling a ring in their hand they turn in the direction of the enemy and lie so that the elbow of their right arm touches the cord, then they install the mine at a distance equal to their extended left arm (1.3-1.4 meters).

After installing the second mine the first members of the details, guiding themselves along the cord, return to the trench.

The second members of the details remain in the trenches as the mining operation begins and, holding the cord reels in their hands, help the first members to unwind the cord. After the reel is fully unwound, the second members of the details let the first members know by jerking on the cord. After that, securing the reel to the peg, and taking two mines, they move out to their farthest mark on the cord (one mine may be installed by the first mark on the cord).

The first mine is installed by the second detail member 2.6-2.8 meters from the cord, for which purpose the soldier executes twice the movement maneuver carried out by the first detail member. After installing the first mine, he then takes the cord in his left hand and moves with the second mine to the second mark on the cord.

The second mine is installed 1.3-1.4 meters to the right of the cord. After the mines are installed and the first detail member returns to the trench, the second detail member gives the cord a sharp jerk, pulling the cord off the anchoring peg, and returns to the trench along the cord, where each detail winds up the cords on the reels.

Subsequent operations are carried out in the same sequence.

The mines may be brought up with the aid of straps or a scraper.

The installation of mines with mine layers and motor vehicles. In order to permit the rapid installation of minefields in the course of the battle along the determined directions of enemy attacks (counterattacks), specially equipped motor vehicles and trailer type mine layers are used on a large scale.

The utilization of mine layers accelerates the mining operation by several times, while decreasing the number of personnel required for the mine laying operation. It is feasible to utilize mines with fuzes equipped with safety pins, while transporting them in an armed condition. In installing mines on the surface of the ground in an area which radioactively contaminated, the safety pins

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are removed before the mines are lowered through the chutes. If subsequent installation of the mines into the ground involving manual camouflage is called for, the mines are then lowered through the chutes with their safety pins. The pins are removed after the mines are installed in the mine holes. By way of an example let us examine several cases involving the installation of a minefield with the aid of trailer type PMR-2 mine layers.

If only one mine layer is available the subsequent distribution of the mines over the minefield by hand (Fig. 30) may be carried out by the subunit in the following sequence:

Mines with safety pins are placed on the surface of the ground in two rows, at intervals of two meters. The mines are lowered simultaneously through two chutes.

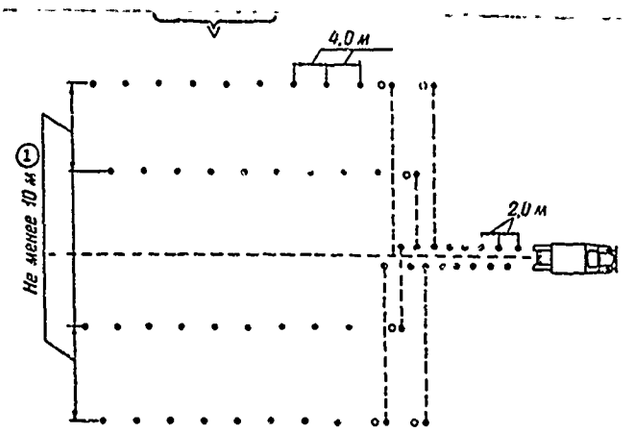

Fig. 30. Diagram showing the installation of a minefield with one PMR-2 mine layer.

Legend: Not less than 10 meters.

Two soldiers are assigned to each layed out row of mines for the purpose of distributing the mines over the minefield and installing them (first and second members of a detail);

On orders of the subunit commander the soldiers approach the laid out mines, each detail member picks up one mine, after which the mines are carried to the right and to the left of the axis along which the minelayer is moving. The first detail members carry them a distance of 25-30 paces, while the second detail members carry the mines 8-10 paces. The mines are laid on the ground, and the safety

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pins are removed (or the fuzes inserted);

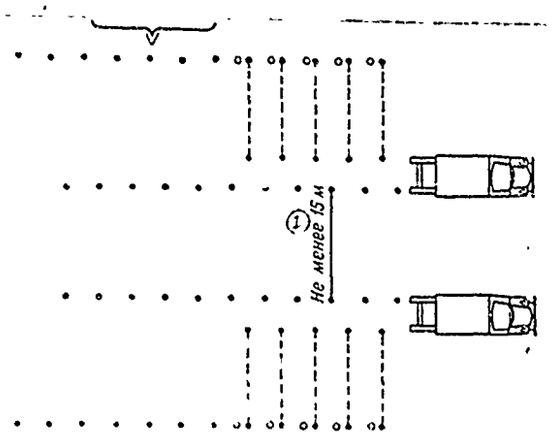

Fig. 31. Diagram showing the installation of a minefield with two MPR-2 mine layers.

Legend: 1 -- Not less than 15 meters.

On the command "Go for the mines," the first detail members approach the second detail members and then together return to the axis line along which the mine layer is moving, where they again pick up a mine a piece, carry them away and install them.

Subsequently the work on the installation of mines is carried out in the same sequence.

If two mine layers are operating the distribution of the mines on the surface of the ground may be carried out in the following sequence (Fig. 31);

The mine layers move along parallel routes at a distance of 15-25 meters from each other, the mines are released through two chutes at four meter intervals;

One or several two-man details follow each mine layer. The details approach the outside row of mines, each man picks up one mine and carries it to the right (left) for 10-15 paces, where the safety pin is removed or the fuzes inserted;

On the command "Go for the Mines," the details approach the next mines along the outside row, carry them away and install them.

A two-man detail is assigned to remove the safety pins out of mines forming the middle row.

When three-four mine layers are used simultaneously it is

possible to install a three-four minefield in a single trip by these vehicles. In the course of the mining operation only one chute is used by each mine layer, i.e. each vehicle takes care of one row of mines. In the process of mining the vehicles move along parallel lines at an interval of not less than 15 meters (if the mining operation is conducted at night the minimum distance between the vehicles must be 20 meters). The vehicles may operate at an interval of 15-20 meters.

When installing mines directly from the motor vehicles (armored personnel carriers) it is feasible to use three to four vehicles at the same time, i.e. to install a three-four row minefield simultaneously. If it is decided to install mines directly on the surface of the ground without camouflaging them, the team, servicing the vehicle must consist of four persons. Two of the personnel stay on the vehicle loaded with mines. They pass the mines down to two other team members who follow the vehicle and install the mines handed to them.

When installing a triple row minefield the mines are spaced five paces (4.0 meters) from each other. In order to maintain this spacing the following installation method is recommended: the first team member, proceeding behind the vehicle receives the mine and passes it to the second team member. The latter measures off a distance of five paces, stops, places the mine on the ground, pulls out the safety pin and again measures out the established distance. Continuous work is ensured with the vehicle moving at 304 kilometers per hour.

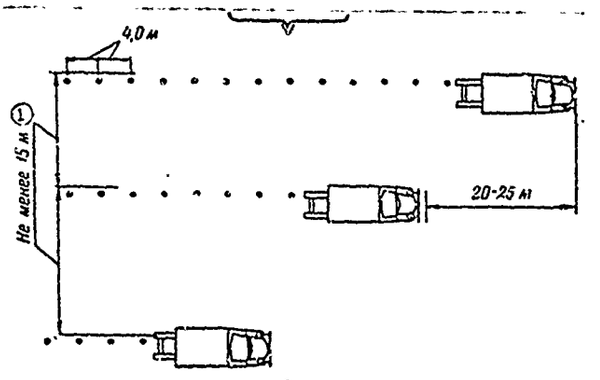

Fig. 32. Diagram showing the installation of a minefield using three PMR-2 mine layers.

Legend: 1 -- Not less than 15 meters

When conducting the mining operation from two vehicles the

method is slightly different. The subunit is broken up into two groups of four men each (if there are not enough men, two groups of three men each are created). On order from the commander the tail gate of the truck is lowered to a horizontal position and two men assume positions by the tail gate. On command the vehicles start moving in the assigned direction at a speed of 2.5-3 kilometers per hour, along parallel routes with a distance of not less than 20 meters between them. The soldiers in the truck move the mines to the lowered tail gate while two other soldiers take turns in picking up the mines and, taking two paces to the right (left) from the vehicle, and placing the mines on the ground. The space between rows must be no less than 10 paces, while the space between the mines should be from six to seven paces.

The mining procedure with two vehicles is the same as that used with two PMR-2 mine layers (Fig. 31).

Mines, distributed on the surface of the ground may be camouflaged. For this purpose an additional team consisting of two to five soldiers, is assigned per mine layer (motor vehicle).

This team moves behind the mine layer. Each team member approaches the mine, digs a mine hole next to it, installs the mine, inserts the fuze (removes the safety pin) and camouglages the mine.

Methods of Installing Antipersonnel Minefields

Antipersonnel mines are installed:

By a detail;
Along a mining cord stretched either parallel or perpendicular to the front of the minefield;
Using the cluster system.

Installation of the minefield by a detail. With a detail it is possible to install only pressure action antipersonnel mines. The mines are installed in accordance with orders issued by the unit commander following the procedures used in the night time antitank mining operations. The installation of mines begins with the farthest row. Depending on the number of rows each soldier takes two to four mines with him per trip.

After installing a mine the soldier assumes a position one meter from it. Then, on the order "About face, five paces, march," the members of the detail march for five paces and stop. On the command "One (two) paces to the left (right)," the men execute the maneuver and install the second mine, then repeat the procedure again.

Installation of mines along a mining cord. Mines are installed along a mining cord stretched parallel to the front of the minefield only on terrain not under enemy surveillance. Two teams of four men each are assigned to the mining operation. One team works along one of the cords, while the other team installs mines along the other cord. Let us examine the installation of pressure action mines.

In each of the teams the first and second team members carry 25-30 mines each in a kit-bag. They also stretch out the cord and place mines next to the cord at intervals of 1-2 meters. The third team member digs mine holes next to the mines, inserts fuzes, camouflages the mines and removes safety pins. In the meantime the first two team members move the cord and stretch it over a new area.

The second team member moves behind the first one at a distance of 20-25 meters.

When installing pull action mines the first two team members carry 10-15 mines in their kit-bags, together with pegs and the mining cord. The third team member carries the trip wires and an ax or a hammer. The fourth team member carries the fuzes, shovels and safety pins.

The first and second team members stretch out the cord, then distribute the mines opposite the rings (markers) on the cord, after which they move the cord to the next position. The third team member drives the trip wire peg into the ground, secures one end of the wire to it, stretches the wire to the mine and connects it temporarily. After that he drives a peg for mine type POMZ or digs a mine hole for the bounding mine of the OZM type and moves on to the next peg. After the third team member moves away the fourth team member installs the mine, with the trinitrotoluene block already in it, on the peg, or places the mine in the mine hole and camouflages the bounding mine; inserts the fuze, stretches the trip wire and secures it to the retaining pin, leaving a certain slack, he pulls the safety pin out of the fuze and moves up to the third team member. The second team member moves along the second row at a distance of 20-25 meters.

On terrain which is under enemy surveillance, for instance in the forward area, the mines are installed along a cord stretched perpendicular to the front of the minefield (Fig. 33). Pressure action mines are installed by that method.

Prior to the mining operation the subunit is broken up into two man teams. The commander positions the teams in the trench at a distance of four meters from each other. Each team takes a mining cord, eight antipersonnel mines (four mines per man), and entrenching tools for digging mine holes. The installation procedure is the same as that for antitank mines. The first team member installs four mines to the left of the cord and returns to the trench holding on to the cord with his left hand. The second team member installs his mines to the right of the cord and, removing the pin, returns to the trench holding on to the cord with his right hand. This ensures safety in the mine operation.

The first team member installs the first mine at the end of the cord, the second mine to the left of it at a distance of about one meter. After that he crawls back 2-4 meters (to the ring or

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or marker on the cord) and installs the third mine half a meter from the cord. The fourth mine is installed one meter from the third one.

The second team member installs his mines in the same order.

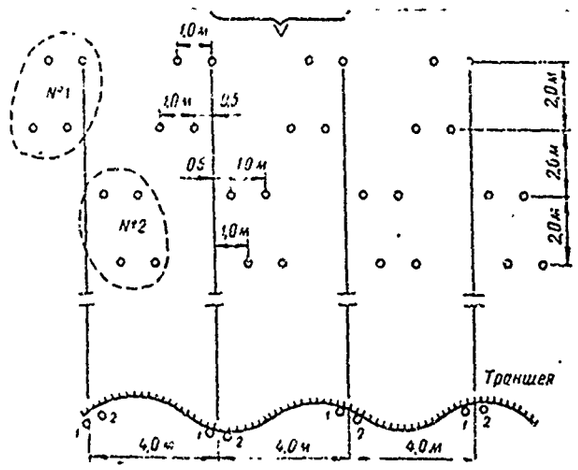

Fig. 33. Diagram showing the installation of antitank mines along a mining cord.

Installation of mines using the cluster system. Pressure or pull action antipersonnel mines may be installed using the cluster system. Two men, who bring up and install mines by themselves, work in a certain sector of the terrain (cluster) delineated by natural landmarks.

Each soldier takes 15-20 mines with him in the kit-bag, along with fuzes, detonators. If pull action mines are to be installed the soldiers also take along pegs, hammers and wire. The men install mines moving from landmark to landmark in the required direction, without returning the same way they came. This method of installing mines is sufficiently safe, since it precludes the possibility of getting on previously mined areas.

The operational norms for successful mining operations are cited in Supplement 1.

Camouflaging Mining Operations When the Enemy is Equipped for Night Vision

In addition to means of artificial illumination of the battlefield and electronic means of reconnaissance and observation, the armies of the capitalist states also use instruments for night vision

that permit the observation of objectives by illuminating them with infrared light projectors.

By using instruments for night vision the enemy is able to reveal the activities of soldiers engaged in mining operations, if the mining teams do not carry out special measures to camouflage mining operations.

Let us examine the properties of instruments for night vision, their strong and weak points, in order to better evaluate the capability of these devices so as to permit the determination of the main methods of camouflaging the installation of minefields during the hours of darkness.

The range of devices operating in conjunction with infrared projectors depends to a considerable degree on the meteorological conditions and decreases considerable in fog, rain or during a snowfall. Even in light fog the range decreases by 2-3 times, while in fog of medium density the range decreases by 6-10 times.

A sharp decrease in the range of the infrared instruments in fog is caused by the absorption and scattering of infrared light by particles of moisture, and by the decrease in the contrast of the objective being watched because of the increased brightness of the atmospheric background, created by the rays of the infrared projector. This also explains the fact that the instruments are practically useless in smoke.

In addition to that the range of the infrared instruments decreases when sources of bright light appear in the instrument field of vision. If light from fires, flares, large bonfires and the like strikes the instrument, a phenomena then occurs that is similar to the temporary blinding of a car driver by the headlights of an oncoming car. A light spot appears in the instrument that prevents the observation of objects that are not as bright.

It is necessary to point out that infrared projectors may be spotted with the aid of the special BI-8 field glasses from a distance tens of times greater than the range at which objects illuminated by the infrared projector may be viewed.

In addition to the above infrared instruments for night vision have a number of strong points complicating the camouflaging of mining operations.

The range at which objects, observed through the instruments, may be detected and identified increases by 30%-40% if the objects are moving.

Objects moving in a direction vertical to the line of observation are observed best.

In addition to that all objects that reflect light are easier to see than those that absorb the light. A soldier, for example, wearing combat gear, is detected first of all by the glint of the unpainted metal parts of his weapons, his helmet, buckles, shined boots and even buttons. An uncovered face is easily seen as a bright white spot. The typical silhouette of a soldier -- the round helmet, protruding outlines of his weapons and the like, stands out sharply against the overall background.

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It is also necessary to point out that all, even the weakest light sources (a burning cigarette shielded or a lighted match shielded with the hand), are visible from a significant distance.

Having evaluated the weak and strong points of the instruments for night vision, operating in conjunction with infrared projectors, we can recommend certain uncomplicated techniques for camouflaging mining operations. The same methods of camouflage may also be used in the performance of other missions during the hours of darkness.

The basic technique that ensures a reliable concealment of the soldiers engaged in mining operations, is the performance of all the operations involved in the installation of mines in the prone position. The man can move across the minefield only by crawling.

If the situation permits the mining operations are started after midnight. By that time fog usually accumulates in the depressions which hinders observation through the infrared instruments. If there is a light fog close to the surface of the ground, the enemy cannot detect soldiers installing mines in the prone or the bent over position. At the same time it is dangerous to move around on the field in the erect position since the head, shoulders and weapons may extend beyond the fog cover.

If there is no fog a smoke screen may be used. The use of smoke cover is very effective but it should be used with the observation of a number of rules. The smoke screen is always laid along a broad front or simultaneously in several sectors and not only where the mines are being installed. In addition to that it is possible not to notice an advancing enemy at night and in the smoke. Therefore observers are posted by the edges of the smokescreens, and reliable fire cover is ensured for the personnel engaged in the mining operation.

It is a good practice to post special observers with instruments and signaling devices in the forward area during the mining operation. The observers, detecting an infrared beam approaching the sector being mined, give a signal stopping all activity and movement. As soon as the infrared ray shifts elsewhere the mining operation may be resumed.

Fires burning in the friendly rear in the course of the battle are used to camouflage mining operations. It will be difficult for the enemy to detect soldiers through their infrared instruments against the background of a fire. It is, however, necessary to remember that the personnel may be detected in the light of the fires with conventional instruments. Finally, in preparing for a mining operation, all objects that reflect light (weapons, helmets, instruments, etc.) must be covered with pieces of old uniforms. Camouflage smocks and suits are donned for the same purpose. It is important to cover the face with gauze. Clumps of grass and branches selected depending on the natural terrain background, are woven into the caps, shoulder boards, helmet straps, and belts for the purpose of distorting the characteristic outline of the human figure.

It is prohibited to smoke, light matches, or use flashlights during the mining operation. It is important to remember that the light from a flashlight pointed even away from the enemy, may be noticed through infrared devices.

Thus, by observing simple and easily carried out techniques and methods of camouflage, it is possible to remain unnoticed by the enemy observers.

The Mining and Demolition of Roads

The high degree of mechanization and motorization of the modern land armies, as well as the accelerated tempos of the combat operations, tie the combat operations of the troops to the existing network of roads. The roads are needed by the warring sides not only to keep the troops supplied, as was the case in the past war, but also to ensure the conduct of highly maneuverable combat operations.

In this connection the mining and demolition of roads for the purpose of slowing the movement of enemy combat and transport vehicles, limiting the maneuverability of his troops, and disorganizing the material and technical supply system, acquire considerable significance.

Dirt roads are mined with antitank and pressure action antipersonnel mines, as well as with explosive charges.

It is self evident that it is quite impossible to mine a road along its entire length since there will not be anough manpower or equipment to do so. Therefore it is recommended to install mines in small clusters of three to five depending on the width of the road.

The clusters of mines are installed in sectors 100-150 meters long (Fig. 34) depending on the terrain conditions. Points that are difficult to bypass (in a forest, on a slope, on a swamp) are selected for mining.

If such areas do not exist nearby, the bypasses are also mined in addition to the main road. Minefields installed along possible bypasses should be positioned so that they would adjoin natural obstacles. This will further complicate the enemy movement and will compel him to clear a way through the obstacles.

The following technique is used in order to increase the destructive effect of the mines on the combat equipment of the enemy, and in order to complicate minesweeping operations with roller exploders and flail exploders.

An explosive charge of 20-25 kilograms (a box of trinitrotoluene) is buried in the road at a depth of 1-1.5 meters. A cluster of antitank or pressure action antipersonnel mines are installed at a distance of 4.0-4.5 meters from it.

The explosive charge and the mines are linked together with demolition cord. When a tank with a sweeper or without a sweeper passes over one of the mines in the cluster, the explosive charge will be set off simultaneously with it, which will destroy the tank and

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demolish the road. Antipersonnel PMD-6m mines may be used as initiating mines by installing them in shallow mine holes.

This method of mining requires very careful camouflating of the mines, the demolition cord and the explosive charge. If the situation permits the mined area is bisected with wheel tracks before the fuzes are installed in the mines and the detonator in the charge. Wheel tracks on the road conceal the freshly excavated earth.

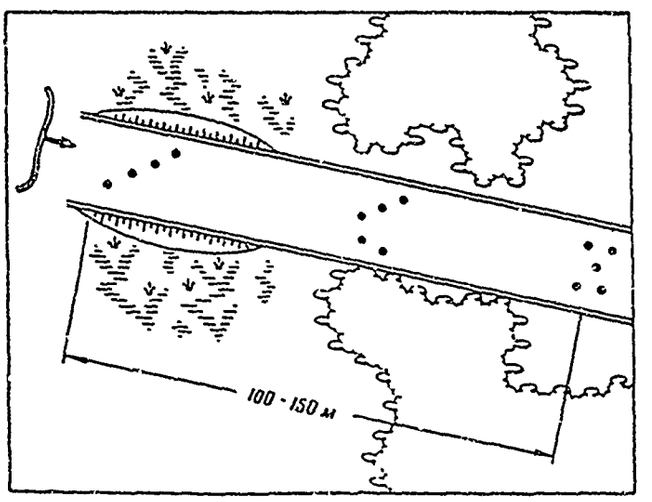

Fig. 34. Diagram showing the mining of a road sector.

A four man team headed by the unit commander are assigned for the mining operation. The first team member digs a hole for the charge, the second team member prepares a shallow pit for the demolition cord, while the third team member installs the cluster of mines. The unit commander supervises the work and helps with the installation of the charge. After the hole for the charge, the pit and the mine holes are dug, the charge is placed in the hole, one end of the demolition cord is connected to it, after which it is carefully covered and camouflaged. The demolition cord is connected to the mines by the unit commander after the team moves away to a safe distance. It is possible to use mine layers to accelerate the installation of mines on roads. The mines are distributed on the road in clusters. Because of the absence of camouflage, however, the effectiveness of the obstacles will be low. Booby traps are used to increase effectiveness. Antitank mines with pressure action fragmentation antipersonnel mines installed along the edge of the road are connected with wire. When attempts are made to remove the antitank mines from the road the antipersonnel mines are set off destroying enemy combat engineers.

Paved roads are destroyed with concentrated charges. A hole is made for this purpose in the surface of the road with the aid of a

KZ-2 shaped charge. Then the hole is widened and deepened using a hand drill. In order to install a 20-25 kilogram charge, a hold is first made by exploding a 1-1.5 kilogram charge. The main charge is placed in the hole formed by the explosion. The main charge is driven in and detonated. The explosion of a 20-25 kilogram charge forms a crater 5-6 meters in diameter. The craters in the road are made in a checkered pattern in sectors, using the same principle as in mining.

CHAPTER 1II

THE SIMULATION OF MINEFIELDS

In training the troops minefields are frequently installed consisting of inert mines, which, instead of an explosive, contain an inert filler in the form of a mixture of slag, sand and cement.

When a tank or an armored personnel carrier roll over such mines no signal is given and it is therefore impossible to tell that a mine has been hit. The latter circumstance leads to a situation where during reconnaissance, minefield breaching, and the crossing of minefields many conditionalities are permitted. Frequently cleared lanes are not made at all, i.e. the tanks and motorized infantry travel freely over a minefield. In other words the subunits not only fail to receive practical experience in the breaching of obstacles, but, on the contrary, cease to take into account the danger presented by minefields.

In order to train the troops in rapid and literate antitank and antipersonnel minefield breaching obstacles are created using simulation devices. The simulation devices, when set off, give a smoke or a light signal, noticeable by the participants of the exercise and the referees.

The detonation of antitank and antipersonnel mines is designated with the aid of simulation devices. The mine simulators permit personnel to note and react in all cases when a mine is set off by tanks, which makes it possible to create a situation closely resembling actual combat and to evaluate the role of minefields under the present day conditions. The use of mine simulators injects discipline in the actions of the subunits, forces them to conduct thorough reconnaissance, just as in actual combat, to clear lanes and cross minefields in accordance with all the rules and with the observance of safety measures.

Let us examine the means used in simulating minefields, as well as the rules involved in their installation and utilization.

At the present time the UITM-60, UTMD-B, UPOMZ-2, and UPMD-6 standard issue antipersonnel and antitank practice mines. In addition

to that signal mines (Fig. 35) may be used with success as simulators.

The UTMD-B, UPMD-6 and UPOMZ-2 mines are copies of combat mines, except that they contain an inert filler. Instead of a booster charge the UTMD-B mine contains a simulation cartridge, while in the UPOMZ-2 and UPMD-6 grain simulators are substituted for the explosive charge. The detonation of antitank and antipersonnel mines is simulated by the appearance of white or orange smoke. Several tens of seconds, however, elapse between the time the mine is set off and the time the smoke filters through the mine casing and the camouflage layer of dirt.

In that period of time the tank or armored personnel carrier that set the mine off travels a considerable distance.

In order to avoid that, it is feasible to install the smoke simulator cartridges in mine casings, i.e. separately. Then the smoke becomes visible as soon as the tank track of the wheel of an armored personnel carrier rolls off the simulator.

Fig. 35. A signal mine.

In order to ensure rapid ignition it is advisable to install the smoke pot (cartridge) so that its upper part protrudes one or two centimeters above the surface of the ground. It is best not to cover the smoke pot with dirt. It should be camouflaged with grass, leaves or with other handy material.

The smoke pots are ignited by practice detonators of the UIMD type consisting of striker, a primer and the detonator cap case. In order to ensure a better flame when the flash igniter goes off, the foil covering the opening in the detonator cap case is perforated.

Simulation cartridges that have been stored for a long time sometimes fail to go off. In order to guarantee the ignition of the smoke composition some gunpowder or a gunpowder paste from the safety fuze are added into the central well of the cartridge.

The detonation of the UIMD detonator is brought about with the aid of the firing mechanism of the MV-5 fuze. The MV-5 fuze has a pressure surface of a very small size. Whereas the size of the pressure plate on the antitank mines comes to an average of 20 X 20 cm. In order to ensure realistic conditions it is recommended to install boards of the corresponding length over the fuze (Fig. 36).

It is possible to dig the holes for mine simulators with shovels. This, however, requires a lot of time, and the cartridges are not firmly secured in such holes. In order to accelerate the digging of holes it is feasible to make holes in the ground corresponding

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to the size of the cartridge. The cartridge is then firmly secured in the opening without supports and, in addition to that, the unmasking features of a mining operation are decreased to the minimum.

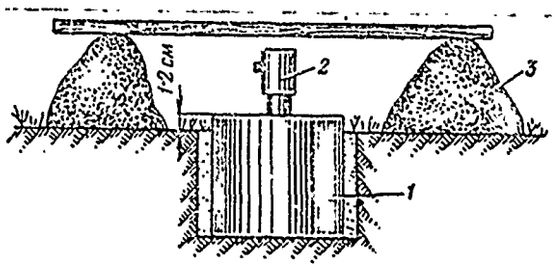

Fig. 36. Installation of a mine simulator with the MV-5 fuze.

Legend: 1 -- Simulation cartridge; 2 -- MV-5 fuze; 3 -- Mounds.

All the simulation devices signaling the detonation of mines with smoke are of little use at night, in fog or poor weather (rain or snow). In addition to that white smoke from the cartridge (particularly in the first moment of its appearance) is easily confused with smoke from the tank's exhaust pipe. In this connection simulation devices which produce a light signal are more useful. This group includes signal mines and signal cartridges used in the UITM-60 practice mine.

When a signal mine goes off a sound signal is given lasting from eight to ten seconds and audible at a distance of up to 500 meters. The sound signal is followed by the light signal in the form of green, white and red lights that are shot up to a height of 15 meters. A single mine may contain up to 12-16 such lights. Both the light and the sound signals are noticeable at a distance of up to 500 meters.

The signal mine may be detonated by firing mechanisms of the MUV (MUV-2) and MV-5 fuzes.

The VPF field charge fuze is best suited for simulating antitank mines (Fig. 37). This fuze may be used to simulate not only tank stopping but also tank killing antitank mines.

In order to simulate tank stopping mines the ring is removed from the fuze holder and a wooden pin is up to 12 cm in length inserted (Fig. 38). An opening about 30 cm deep is made in the ground and the signal mine is installed flush with the surface of the ground. The fuze is installed in the mine after it is positioned in the ground.

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In order to arm the mine a snap hook secured to a wire is attached to the lug in the fuze safety pin. The pin is pulled out from a position on the windward side at a distance of not less than three meters from the mine.

A three man team is usually assigned to install a row of signal mines. The first team member moves in the direction indicated to him and at certain intervals makes a hole in the ground for the mine using a crowbar. If a crowbar is not available the holes may be made with an ax and pegs of the SM signal mine set. The second team member carries and installs the mines and arms them with fuzes. The third team member removes the safety pins.

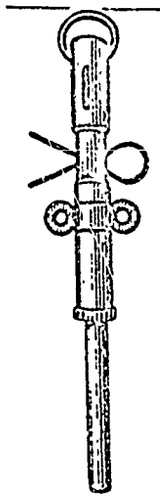

Fig. 37. Fuze for VPF field charges.

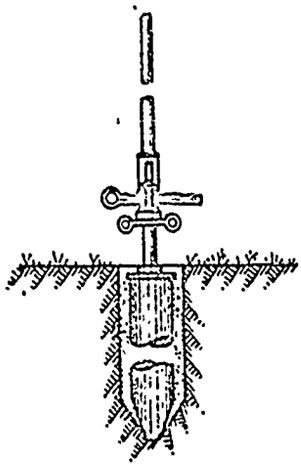

Fig. 38. Antitank mine simulator with the VPF fuze.

Tank killing mines are also simulated with the aid of the VPF fuze firing mechanism. In this case, however, the pin inserted in the fuze must protrude not less than 60 cm above the surface of the ground. The mine is set off when a truck wheel (axle), a tank track or the bottom of the tank brush against the pin.

If the tank is moving at 10-15 km/hr the audio signal will be heard while the tank is still over the mine, while the signal lights will be ejected after the tank has passed.

The signal mines may be used as a means of simulation both independently, and in combination with mines with inert filler. In the latter case the signal mines are installed to the rear of

the inert mines, 10-20 cm in range of the anticipated movement of tanks.

In order to conserve signal mines, the minefields installed in the forward area should be simulated only in areas where lanes are to be cleared using the blasting method. The signal mines with short pins are set off by the detonation of a distributed charge from about the same distance as the ordinary tank stopping mines.

Signal mines simulating the detonation of tank killing mines are installed at intervals of 3.3 meters. An equal number of signal mines are installed in all the rows of the minefield since the chances of a mine being hit in any of the rows is precisely the same. Such a minefield has a kill probability close to 100%. In order to decrease the expenditure of signal mines it is recommended to install mines along the tank firing tracks in creating minefields deep in the defensive lines.

Signal mines are successfully used in simulating the detonation of charges by the electrical method. An electric primer with the empty part of the case sawed off is placed in the casing of the MUV fuze, a little gunpowder is added and the firing pin from the MV-5 fuze is installed. After that it is carefully coupled with the signal mine. It is necessary to bear in mind that the gap between the point of the firing pin and the flash igniter of the signal mine is small, therefore the body of the MUV fuze is screwed on the mine coupling base no more than one turn. As the electric firing pin is set off it is pushed with sufficient force to impress the primer cap.

Despite the effective light signal which is produced by the signal mines, and their comparatively light weight and ease of installation, the use of such simulating devices is still limited. Signal mines cannot be installed by mechanical devices. They are installed only by hand and ahead of time. They cannot be used when operations of mobile obstacle detachments are being practiced.

It is possible to install simulated antitank minefields with the aid of trailer type mine layers or from motor vehicles only if the UITM-60 mines are used. When the signal cartridge is set off the mine produces an effective light signal that is easily visible from a distance of up to 500 meters.

The discharged mine is easily re-fitted. The signal cartridge is the only item that is expended, the mine itself, installed in the ground, sustains no damage from the tank tracks or the wheels of an armored personnel carrier.

Occasionally the bottom of the mine is bent by the tip of the fuze. This is easily repaired with the aid of the lathe which is part of the UITM-60 set.

The detonation of mines and simulation cartridges in the hands or in direct proximity to uncovered parts of the body may result in serious injuries and burns. Therefore in handling the simulation devices it is necessary to be just as attentive and careful as in the handling of real mines.

Pressure and pull action antipersonnel mines should not be simulated with signal mines because of the fact that when the mine goes off the fuze, together with the rubber washer and packing, is shot up to a height of 15 meters and can injure a person.

It is possible to move across a simulated minefield with signal mines only along tracks made by the tanks. If the participant of a training exercise hears a flash igniter or a signal mine going off he must walk three-four paces away from the burning simulation device.

Signal mines and the UITM-60 mine simulators with signal cartridges may not be installed in the proximity of hay stacks, grain stacks and the like, since the light signals may not burn out while in the air and, after landing on easily inflammable objects, can start a fire. After the end of training exercises all the simulating devices must immediately be disarmed or destroyed. In order to facilitate the finding of installed cartridges and mines all the minefields are carefully plotted on the terrain and a detailed minefield record is compiled.

The simulation cartridges and signal mines that were not set off are disarmed for future use. The VPF fuzes are removed from the signal mines only after the safety pins are inserted.

A strict accounting of the mines that are removed and of those that were set off is kept.

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CHAPTER IV

MINEFIELD RECORDING

A record is prepared for each minefield that is installed. This record is the main document pertaining to the minefield.

The record must be compiled by the time the mining operation is finished. The record, together with the report indicating the completion of the mining operation, must be forwarded to the senior commander on whose orders the mining operation was carried out.

The minefield record form (Supplement 3) consists of a textual part and a minefield reference sketch.

The textual part of the record contains the main data about the minefield; mining date, type and number of mines, distances between rows, distance between mines in a row, method used in installing the mines, for example, along a mining cord stretched perpendicularly to the front of the minefield, or with the aid of mine layers. The record contains notations concerning changes in the condition of the minefield, on the results of inspections, and, with a change in the subunit, notes on the transfer of minefields. When necessary the record lists individuals to be acquainted with the distribution of obstacles on the terrain.

After it is filled the record is classified secret and must be destroyed if there is a chance that it may fall into enemy hands.

The compilation of a minefield reference involves a determination of its boundaries (angle points) relative to the main reference points both on the map and on the terrain. Therefore the minefield reference sketch (Fig. 39) indicates the outline of the minefield and not less than one main reference point, as well as the azimuths and distances from the reference point to the angle points of the minefield.

For general orientation purposes the sketch includes the nearest local features: roads, rivers, populated points, forests, etc. It is desirable to select reference points close to the minefield. This simplifies the tie-in of the minefield and makes it easier to find the obstacle later.

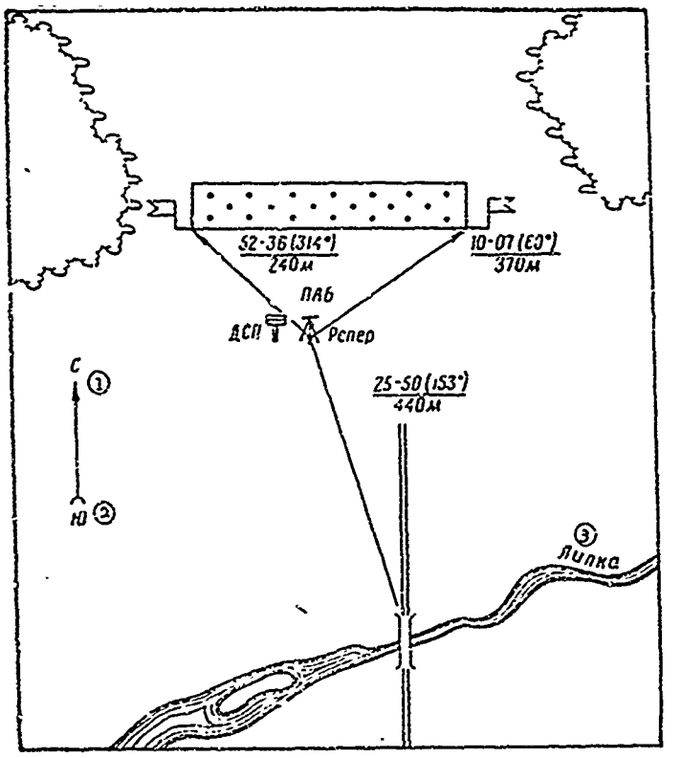


Fig. 39. A minefield reference sketch.

Legend: 1 -- North; 2 -- South; 3 -- Lipka.

Reference points should not be picked on the side facing the enemy. It is also forbidden to indicate azimuths which, if followed, would lead across the minefield. The main reference point should be an object that cannot disappear without a trace as a result of fire (a bridge, crossroads, trigonometric symbol) or one that can be easily restored.

What if there are no reference points available near the mine field? In that case a landmark is selected (trench, dugout) which is then referred to the main reference point.

Minefields installed in the defense zone, particularly at night, for the purpose of covering the troop positions, may be referred to the trenches since there may be no other reference points.

A brief legend is compiled on the main and landmark reference

points on the minefield reference sketch. The legend indicates the peculiarities of the selected reference points, and the exact spot from which the measurements were taken is indicated (north bridge pile, entrance into shelter, etc.).

If the minefield is installed by hand, i.e. the process of its installation takes a long time, any means of referencing the minefield are suitable. A special instrument is usually used for minefield recording. Referencing with the aid of a recording instrument, however, takes no less than an hour. If there is no instrument, referencing is accomplished by eye.

The minefield reference sketch is compiled right after it is laid out. For this purpose the subunit commander or one of the best trained sergeants proceeds to a point selected as the main or landmark reference point. With the aid of a compass or an aiming circle he measures the azimuths to the markers designating the outline of the minefield.

Distances are measured with a tape or measuring cord, or paced off. The obtained results are entered in the record form.

The plotting of a minefield reference sketch will be made easier if a previously prepared sketch to the scale of 1 : 5,000 - 1: 10,000 is used. The sketch may include landmarks (trenches, large craters) which are not on the map. Even though the method of referencing the minefield by eye is quite simple it is not sufficiently accurate.

In modern combat most of the minefields will have to be installed within short periods of time along the direction of enemy attacks (counter attacks) using various technical devices. This complicates the referencing of minefields and, in this case, a referencing system is required that does not require complex instruments and permits a rapid execution of the mission. In addition to this the system must also be devoid of shortcomings inherent in the system of referencing by eye.

A range finder or an artillery aiming circle may be used for referencing the minefield. This method of referencing yields good results, and the referencing work may be done by sergeants. All the officer has to do is check the accuracy of the final documentation and help the sergeants should they encounter difficulties.

The referencing of the minefield with the aid of an aiming circle and a range finder is carried out by a two man team. Before starting the referencing work they designate the angle points of the minefield with markers, select the main or landmark reference point, install the instruments, determine the coordinates (azimuths and distances) to the angle points of the mined sector relative to the main or the landmark reference points, and plot the outlines of the minefield on the form.

The distances to the angle points of the minefield are measured with a range finder while the azimuths are determined with an artillery aiming circle. Errors in the determination of the distances by a trained team, as a rule, do not exceed 1%-2% for distance, and 10-12 thousandths divisions on the goniometer (less than 1%) for the azimuth.

Considerable effect on the accuracy of the azimuth measurement and particularly on the measurement of distances, is exerted by the markers. The angle points of the minefield should therefore be designated by specially prepared square shaped markers (8 x 8 cm), 2.0-2.5 meters high (Fig. 40). Three sides of these markers are painted white on which a black stripe 1.25-1.5 meters lons is painted. The width of the stripe on the various markers is different and amounts to: 1 cm for measurement of distances up to 200 meters, 3 cm for distances up to 600 meters, and 6 cm for distances in excess of 600 meters. A glass tube 1.25 meters in length is secured to the fourth marker. Flashlight bulbs connected to a KBS battery are attached to the end of that marker. With the aid of these markers the team measures distances of up to 150 meters with an accuracy of within 20-30 cm.

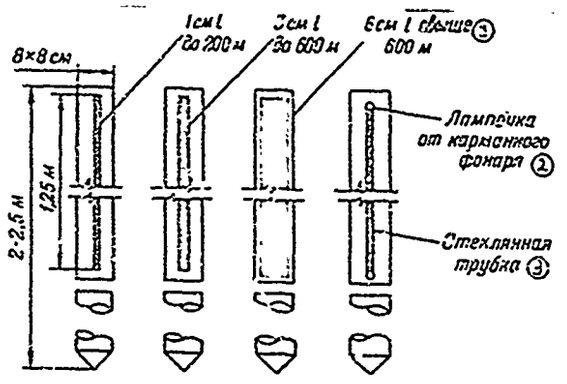


Fig. 40. Markers for designating the boundaries of a minefield when it is being laid out.

Legend: 1 -- Over; 2 -- Flashlight bulb; 3 -- Glass tube.

A stake 60-70 cm long and 10-12 cm in diameter is driven into the ground near the main (landmark) reference point. The stake must protrude 5-7 cm above the surface of the ground. The aiming circle is installed directly over the stake. The range finder is positioned next to it (to the right or left). A simple stand should be constructed to support it since that would permit a more accurate measurement of distances than if the instrument is hand held.

The first team member, after orienting his aiming circle according to the compass points, aims the cross hairs in the eyepiece of the aiming circle at the marker designating the nearest angle of the minefield, and determines the azimuth using the deflection drum and the circle. He relays the numerical value of the

azimuth in thousandth divisions of the goniometer by voice to the second team member who records this data on his plotting board. After the azimuth is measured the first team member moves to the range finder, aims it at the marker and determines the distance. He relays the distance reading to the second team member. The azimuths and distances to the other markers and reference points are determined in the same manner.

It is important not to have both team members operate the measuring instruments. It is possible that the team members will simultaneously sight on different markers which would result in incorrect data.

The second team member, equipped with a plotting board to which a form is attached, an artillery plotting protractor and a triangle (it may be taken from the set for recording minefields), plots the azimuths in scale and draws the minefield reference sketch. (Fig. 39).

It is best to indicate the azimuths on the minefield reference sketch not only in thousandths divisions of the goniometer, but also in angles. This will preclude errors should recalculation be required, and will not be confusing to some other minefield team which is not acquainted with the operation of the aiming circle and uses a compass for this purpose. In addition to that the minefield reference sketch may be plotted in scale using an ordinary protractor.

In order to convert thousandth divisions of the goniometer into degrees it is possible to use a very simple method. It is known that the aiming circle is broken down into 60 large divisions. This means that each division is equal to 6!. Every large division is broken up into 100 small divisions (the reading is taken from the deflection drum). Hence 1! corresponds to $\frac{100}{6}$, or to about 17 small divisions.

In order to convert the azimuth value (measured in thousandth shares) into degrees it is necessary to multiply the number of large divisions by 6, divide the number of small divisions by 17 and round the figure out to whole numbers. The results should then be added up.

For example, let the measured azimuth be equal to 20-70 thousandths. It is necessary to determine its value in degrees.

For this $20 \times 6 + \frac{70}{17} = 120 + 4 = 124!$

With the aid of a measuring circle and a range finder it is possible to successfully reference minefields installed in the course of the battle when mine layers and trucks are used.

Let us assume that the commander of a subunit was assigned the mission of installing a minefield along a certain line. In assimilating the mission and evaluating the situation the officer at the same time specifies the reference point to which the minefield must be referenced.

The route to be followed in reaching the minefield site is selected so that it passes near the referencing point.

In addition to that when issuing the mining mission the subunit commander points out:

The reference points;
Brief information on the enemy;
Boundaries of the minefield'
The order in which the vehicles pulling the tractor type mine layers are to move during the mining operation;
The number of mine rows'
Distances between the rows;
Mine spacing'
Method to be used in installing the mines.

This data is recorded on the form by the team assigned to record the minefield.

The team with the instrument for referencing the minefield gets off the vehicle near the point selected as the reference point, and, while the vehicles with the minelayers move towards the mining area, the team installs its instruments. One of the soldiers positions a marker for two minutes by the vehicle from which the rear row of mines will be installed. The marker must be no less than five meters from the mines which provides an extra margin of safety in case of measurement errors during the search for the minefield. At the same time the mine layer is prepared for operation. Two minutes are quite enough to reference one minefield point. As the minelayers move out the marker is removed and replaced in the towing vehicle. The second marker is displayed at the end of the minefield also for 1-2 minutes while the mine layer is being readied for operation. During the mining operation the team, assigned to record the minefield, references the landmark to the main reference point, drives in the siting stake and compiles a brief legend describing the reference points and the nearby landmarks.

Experience indicates that using the aiming circle and a range finder it is possible to reference a minefield 400-500 meters long within 10 minutes.

The minefields are later found on the basis of the reference documents with the same instruments as those used in referencing the minefield. If the azimuths were measured with the aiming circle it is desirable to find the minefield also with the aid of an aiming circle.

A three man team is assigned to find a previously installed minefield. The first team member (senior member) carries the aiming circle and the documents, the other team members carry the measuring tape and the markers.

First the main reference point is found and the aiming circle is installed. The aiming circle is installed at a point reversed with regard to the azimuth shown on the sketch. If the azimuth from the landmark reference point to the main reference point on the sketch was 20-70 thousandths (124!), the aiming circle is installed at a point 60-00--20-70=39-30. Let us check the accuracy of this calculation:

$39 \times 6 = \frac{30}{17} = 234 + 2 = 236!$; $360 - 124 = 236!$.

The first team member selects the reference point in alignment

with the found direction and indicates the distance from the main reference point to the landmark reference point to the other team members. The latter move in the assigned direction measuring the distance with a measuring tape.

Sometimes it occurs that the landmark reference point (dugout, trench) is easily noticed from the main reference point. Then the senior team member dispatches one of the team members to ascertain the accuracy of this position and, on his signal, moves the aiming circle and installs it precisely over the measuring stake driven into the ground next to the landmark reference point. The aiming circle is installed at the same measuring point that was used during the referencing of the minefield. After that first one and then the other angle of the minefield are found and designated. Knowing the number of rows and the distances between them it is not difficult to determine the depth of the minefield, while a knowledge of the mine spacing, the method used in installing the minefield and the number of mines per row helps to find all the mines.

CHAPTER V

MINES AND MINEFIELDS IN THE CAPITALIST COUNTRIES

Antitank Mines

The design of antitank mines during the past several years is being conducted abroad in accordance with the required performance characteristics. In accordance with those requirements the mines must not weigh more than 13.5 kilograms, must not be detonated by the blast wave created by nuclear weapons or by mine clearing charges, they must be undetectable by the modern induction mine detectors, and must function reliably after installation in the ground at a depth of up to 10 cm (from the top of the mine). The mines must be of a type that may be stored and used under conditions involving temperature changes from +54° to -52° C.

The designing of new antitank mines during the postwar years did not cease for a single day in the NATO countries. A particularly large number of models were worked out in France, Italy, Sweden and the US. The Federal Republic of Germany has over the past several years been developing its own models of antitank mines. Even small and neutral Switzerland has developed six types of antitank mines.

The bulk of the existing antitank mines are tank stopping mines, i.e. mines damaging the tank track. These mines are divided into light and heavy mines.

Light tank stopping mines are designed to put out of commission any combat or transport vehicles, with the exception of heavy tanks. The weight of the explosive charge (in terms of trinitrotoluene) amounts to 5-6 kilograms. The desire to retain light mines was, apparently, dictated by the need to use the extensive stocks of mines of postwar production.

Heavy tank stopping mines are designed to damage tracks of all vehicles, including those of heavy tanks. The weight of the explosive charge (in terms of trinitrotoluene) comes to 7-10 kilograms, the gross weight of the mine comes to 13.5 kilograms.

In addition to the tank stopping mines some of the armies (US,

France) are also either equipped with or are developing tank killing mines designed to destroy tanks by blasting through the bottom part of the tank up to 50 mm thick and raised up to 70 cm above the surface of the ground. These mines destroy the tank crew along with the tank.

The modern antitank mines used in the capitalist armies consist of four main parts (units) -- the body, the explosive charge, the firing device and the fuze.

The explosive charge, the firing device and the fuze are absolutely necessary in a mine whereas the body is not a prerequisite part since antitank mines may be used without a body (solid explosive). Most of the present day antitank mines, however, have a metal, plastic or a wooden body.

The diameter of the mine case fluctuates between 200 and 350 mm. The most common dimension of modern mines varies between 300 and 330 mm.

In most countries the mines are filled with trinitrotoluene (TNT) or with fuzed substances and mixtures with TNT as the base (tetritol, baritol, substance "B"). At the same time it is necessary to note the drive to increase the combat effectiveness of the mine not only by increasing the weight of the charge, but also by using more powerful explosives such as tetryl, PETN, hexogen, or by increasing the density of the explosives being used.

A change in the density of the trinitrotoluene-hexogen mixture, for instance, by 0.1 grams/cm^3 increases the rate of detonation by 320-340 m/sec. Vacuum casting, by increasing the density, also increases the rate of detonation. A mixture of 35% trinitrotoluene and 65% hexogen, for instance, produced by means of conventional casting has a density of 1.669 grams/cm^3, while the same mixture produced by vacuum casting has a density of 1.773 grams/cm^3, which increases the rate of detonation of the given mixture by 200 m/sec.

The table given below indicates the properties of trinitrotoluene, tetryl, PETN and hexogen which are used in modern antitank mines.

Explosive	Density, grams/cm^3	Rate of detonation, m/sec.	Specific pressure, kilograms/cm^2	Detonation temperature, °C	Explosive Effect
Trinitrotoluene	1.59	6,700	8,100	2,800	86,000
Tetryl	1.63	7,200	9,800	3,370	115,000
PETN	1.70	8,100	13,100	4,200	180,000
Hexogen	1.82	8,300	14,500	4,100	219,000

The brisance number is equal to the density multiplied by the

detonation rate and specific pressure (for trinitrotoluene -- 1.59 X 6,700 X 8,100 = 86,000). The brisance number describes the brisance of explosives very well.

Most of the antitank mines are armed with pressure action mechanical fuzes. The bulk of these fuzes belong to the group containing a cocked spring. This group, in turn, may be subdivided into the following subgroups according to the method used in releasing the firing spring:

Fuzes set off by the shearing of the safety pin;

Fuzes set off by the rolling out of a striker-retaining ball;

Fuzes set off by the removal of the safety pin or a special retainer;

Fuzes set off by the falling out of a retaining ball, found widespread application in antitank mines produced in all the countries and, at the present time, constitute the main type of fuze for these mines.

Pull action fuzes are used only in the installation of anti-disturbance mines.

It is necessary to note the tendency to manufacture non-metallic pressure action fuzes, including the firing pin and the spring.

Chemical pressure action fuzes are also widely used. These fuzes contain glass ampules filled with acid. The glass ampules for the acid in these fuzes are being replaced with plastic ampules that are more shock resistant. It is necessary, however, to note that the reliability and the detonation rate of the chemical fuzes depends strongly on the temperature of the environment.

Pressure received by the firing device of the mine is a key factor in the reliable function of the antitank mine. It is also necessary to take into account the detonation force and the specific pressure.

The detonation force of the known western mines amounts to 200-500 kilograms, and it is possible to assume that these figures will probably not change in the foreseeable future.

By contrast with the detonation force, specific pressure, which is the relationship of the detonation force to the pressure surface of the mine firing device, has increased considerably during the past several years and now amounts to over 10 kg/cm^2. This makes the modern antitank mines more resistant to the shock wave produced by a nuclear blast or a mine clearing blast.

American mines M6A1, M6A2, M15, M19 and M21 are the most widespread at the present stage in the development of antitank mines.

The M6A1 mine was introduced in 1945. It consists of a metal body, a pressure firing device, an explosive charge, a mechanical (M603) or a chemical M600) fuze, and is, in essence, a variant of the German Tmi-42 mine of World War II vintage.

The gross weight of the mine (without the packing case) is nine kilograms, the explosive charge (trinitrotoluene) weighs 5.4 kilograms, the diameter of the mine is 320 mm. The mine is 90 mm

high, the diameter of the pressure plate is 190 mm; the pressure force necessary to set the mine off varies between 135 and 180 kilograms when the mine is armed with a mechanical fuze, and 250-800 kilograms when the mine is armed with a chemical fuze.

To destroy modern heavy tanks it is recommended to install the mines in pairs, i.e. two mines in each mine hole, or the mines should be loaded with additional charges of trinitrotoluene weighing 3.6 kilograms. These additional charges are produced for this purpose in hermetic containers. Thus the weight of the charge in the mine was increased to 9 kilograms.

The M6A2 mine (Fig. 42) is a partially modified model of the M6A1 mine and is armed only with the M603 mechanical fuze. The mine has two wells (a side and a bottom secondary wells) for installing it in an antidisturbance position. This mine was introduced in 1952.

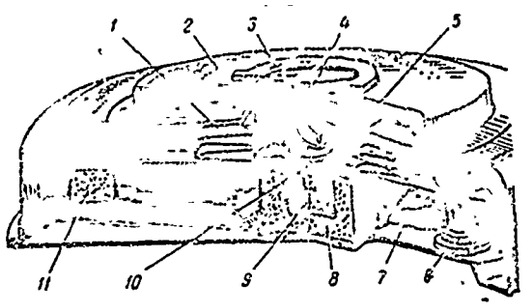


Fig. 41. The M6A2 anticank mine

Legend: 1 -- Belleville spring; 2 -- Pressure plate; 3 -- Coupling base; 4 -- Arming plug; 5 -- Curved pressure lever; 6 -- Bottom secondary fuze well; 7 -- Main explosive charge; 8 -- Booster charge; 9 -- Detonator; 10 -- Main fuze; 11 -- Booster (side secondary fuze.

The M15 mine (Fig. 42) is no different from the M6A1 mine in design and appearance. The gross weight of the mine, however, has been increased to 13.5 kilograms, and the weight of the explosive charge in this mine comes to 10 kilograms. That is why this mine is called heavy. The mine body has a diameter of 330 mm, and is 124 mm high.

The mine is made of metal and is armed with the M603 fuze.

It is considered feasible to use the M15 mines for mining terrain along the most tank threatened sectors and for covering M6A1 minefields against pressure action mine sweepers.

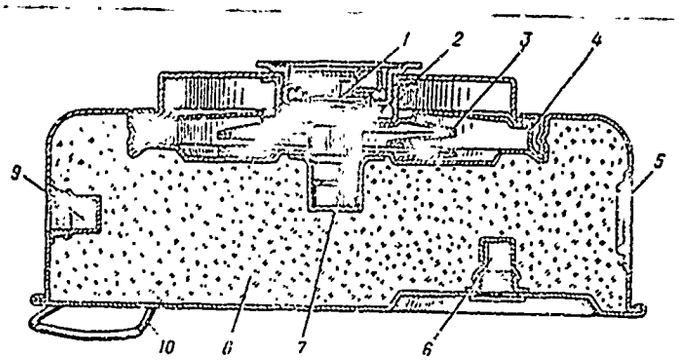


Fig. 42. The M15 antitank mine.

Legend: 1 -- Fuze retainer spring; 2 -- Fuze; 3 -- Bellevelle springs; 4 -- Rubber moisture seal; 5 -- Filling hole; 6 -- Secondary fuze well; 7 -- Booster charge; 8 -- Main charge; 9 -- Secondary fuze well; 10 -- Handle.

The M15 mine was introduced in the armies of the Federal Republic of Germany, France, Italy, Belgium, Holland, Greece and Norway.

The M-19 mine (Fig. 43) is the second heavy mine introduced in 1954. The mine has a plastic body. The gross weight of this mine is 12.7 kilograms, the explosive charge (substance "B") weighs 9.5 kilograms. The mine is square shaped and is 330 X 330 mm in size. The mine is 76 mm high. This mine is armed with the M606 fuze in a plastic housing. The amount of pressure required to set off the mine is about 190 kilograms.

The M21 mine (Fig. 44) consists of a metal body, the M607 (T200E2) fuze and a shaped charge. The gross weight of the mine is 8 kilograms, and the explosive charge weighs 4.75 kilograms. The mine with the fuze is 813 mm high. The mine may also be installed with the M612 pneumatic fuze.

The development of antitank mines in the British Army is proceeding slower than in the other capitalist countries. The British Army is mostly equipped with World War II mines: MkIV, MkV, MkVHC. Only one new mine appeared in 1952 -- the MkVII.

What are the antitank mines used in the British army like/

All the mines are of the pressure action type, have circular metal bodies, and are filled with trinitrotoluene or baritol.

The MkIV mine weighs a total of 5.7 kilograms, the explosive charge weighs 3.7 kilograms, the diameter of the body is 203 mm. The mine is 127 mm high. The minimum pressure required to detonate the mine amounts to 150-200 kilograms. The fuze is installed in the fuze well situated in the central part of the mine.

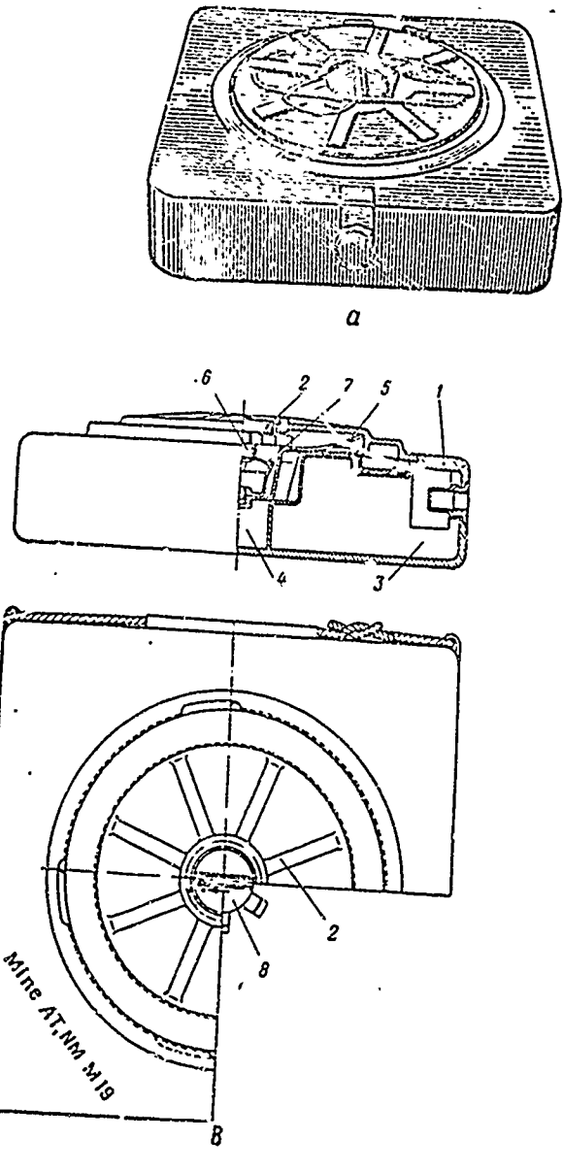


Fig. 43. The M19 antitank mine

Legend: A — Overall view; B — Cross section, 1 — Body; 2 — M606 Fuze; 3 — Charge; 4 — Booster; 5 — Disc spring; 6 — Firing pin; 7 — Firing spring; 8 — Arming plug.

The MkV mine weighs a total of 3.6 kilograms, the explosive charge weighs 2 kilograms, the body has a diameter of 203 mm and a height of 100 mm. The minimum pressure required to detonate the mine is 150-200 kilograms. The mine has a pressure cover that transmits the pressure to the pressure plunger covering the upper part of the fuze situated in the central part of the mine.

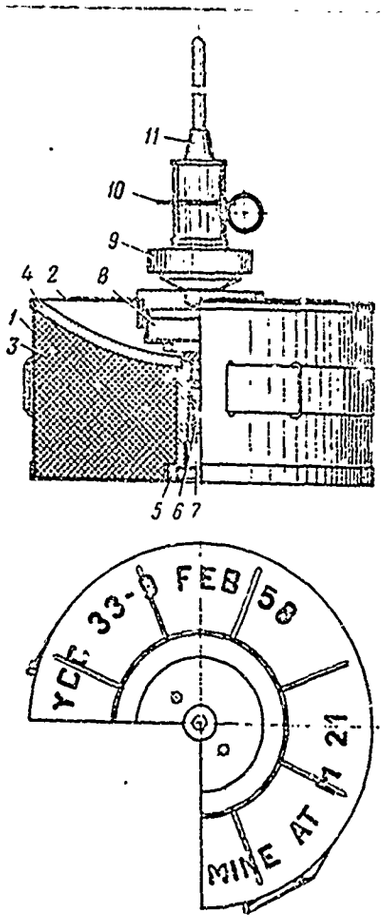


Fig. 44. The M21 cumulative antitank mine.

Legend: 1 -- Body; 2 -- Lid; 3 -- Charge; 4 -- Steel facing; 5 -- Igniting primer; 6 -- Detonation mechanism; 7 -- Booster charge; 8 -- Primary booster charge; 9 -- M607 detonator; 10 -- Safety device; 11 -- Firing mechanism.

The MkVHC mine (Fig. 45) is no different from the MkV mine in its use, design, method of installation and detonation principle, but the gross weight of the mine and the weight of the explosive charge have been increased to 5.4 and 3.6 kilograms correspondingly.

The MkVHC mine was introduced in 1945.

The MKVII mine (Fig. 46) is a heavy mine. Its gross weight is 13.6 kilograms, the explosive charge weighs 9.1 kilograms, the body diameter is 330 mm and its height is 127 mm. The minimum pressure required to detonate the mine is 180 kilograms. The mine is adapted for use in partially mechanized mining operations.

The DM11 mine (Fig. 47) has recently appeared in the army of the Federal Republic of Germany. This mine does not have a case, and it is a tank stopping mine. It does not have any metal parts. The mine has a friction fuze, but after some modernization it will be possible to use it with other fuzes as well, including a fuze that automatically arms the mine 10-30 minutes after it is installed, and with a fuze that precludes disarmament of the mine. This mine was ordered by the Federal Republic of Germany from a French firm.

With a gross weight of 7.4 kilograms the mine has an explosive charge weighing seven kilograms. Its diameter is 300 mm and it is 900 mm high. The pressure required to detonate the mine amounts to 150-400 kilograms.

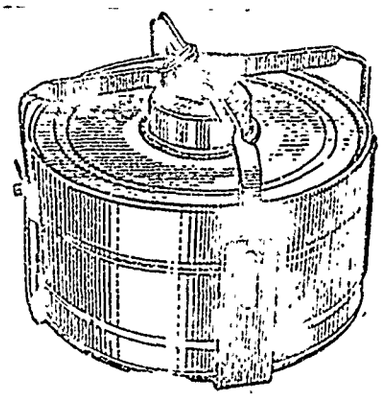
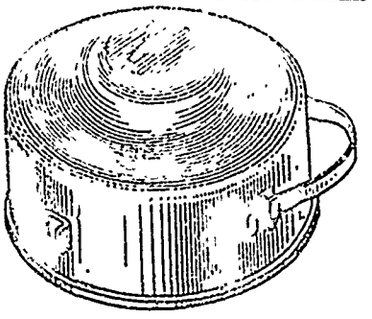


Fig. 45. The MkVHC antitank mine.



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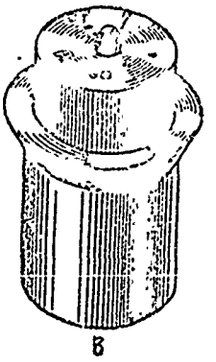

B

Fig. 46. The MkVII antitank mine.

Legend: A -- Mine; B -- Fuze.

In addition to the DM11 mine, the Federal Republic of Germany also developed another antitank mine without a case. This mine is shown in Fig. 48.

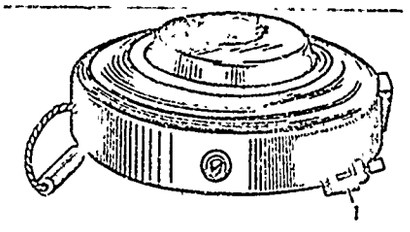

Fig. 47. The DM11 antitank mine.

Legend: 1 -- Fuze.

In France the main types of antitank mines were worked out between 1947 and 1956. During that period some ten models of mines were designed, four of them without cases. In the course of developing tank stopping mines the weight of the explosive charge in them was increased from five kilograms (in a 1947 mine) to 8.3 kilograms (in the heavy mine without a case).

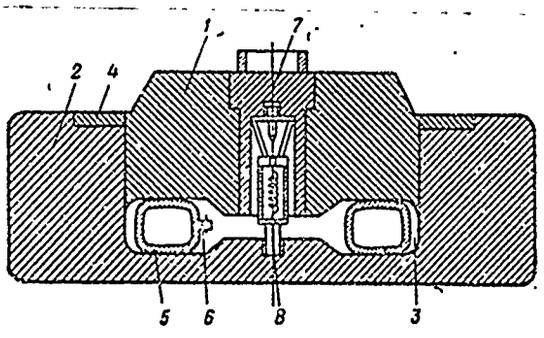

Fig. 48. An antitank mine without a case.

Legend: 1 -- Upper part; 2 -- Lower part; 3 -- Air cushion; 4 -- Protective plate; 5 -- Resilient element; 6 -- Valve; 7 -- Fuze; 8 -- Detonating cap.

Below are descriptions of some of the interesting modern antitank mines used in the French army.

The Mi. A.C. Mle51 model 1951 mine (Fig. 49) is without a case. It weighs a total of 7.3 kilograms, the explosive charge (trinitrotoluene of increased stability) weighs 7.0 kilograms. The mine has a diameter of 300 mm, and is 100 mm high. The pressure necessary to detonate the mine is 150-400 kilograms.

There is a variant of this mine which weighs more -- 9 kilograms. Its explosive charge weighs 8.3 kilograms. This mine has

a diameter of 300 mm and a height of 120 mm.

Non-metallic pressure action, chemical or friction fuzes may be used in the mine. The detonating cap is in a non-metallic cartridge.

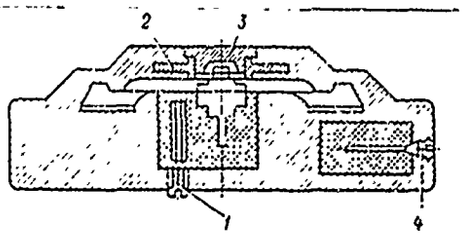

Fig. 49. The Mi.AC.ID.Mie51 (1951) model antitank mine.

Legend: 1 -- Bottom secondary fuze well; 2 -- Rubber sealing; 3 -- Plastic stopper; 4 -- Side secondary fuze well.

The 1951 model mine is a sectionalized tank killing mine. It weighs 3.6 kilograms and contains a three kilogram explosive charge. The mine has a diameter of 170 mm and is 390 mm high. Pressure required to detonate it is 300 kilograms. The mine body is plastic. There is a variant of this mine with a metal body. The gross weight of that mine is 3.8 kilograms and it contains a 1.5 kilogram explosive charge.

The mines are installed in pairs (Fig. 50) using a pressure-

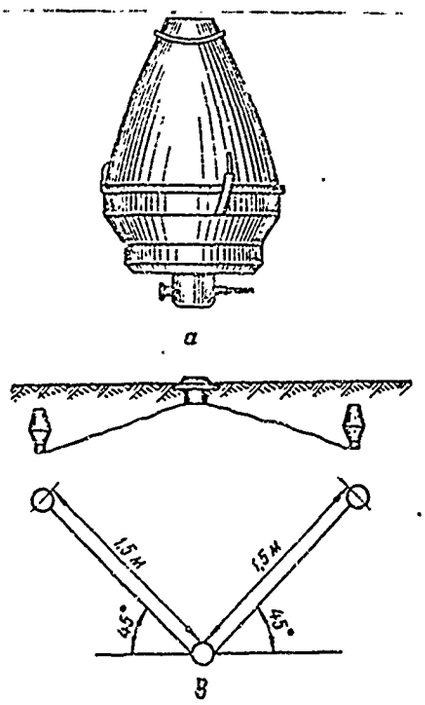

Fig. 50. Antitank 1951 model cumulative mine.

Legend: A -- Overall view of the mine; B -- Installation diagram.

friction firing device and pieces of demolition cord in a special shell. The pressure-friction device is made out of plastic and has a body with a pressure action lid, an explosive charge and a pressure action fuze (friction or chemical fuze).

The mine pierces armor plate up to 100 mm thick.

The 1952 model mine contains a flat charge. The mine does not have a case (initial models were in a case). The mine weighs 11 kilograms, the charge weighs 7 kilograms. The mine has a diameter of 260 mm and it is 100 mm high.

This mine may be used both as a tank stopping and a tank killing mine. The mine is cylindrical in shape and contains a body and a well for the fuzes.

The center of the lid contains a well for a pressure action fuze (tank stopping variant) or a mechanical 1952 model fuze to which a tilt rod 800 mm long is attached (tank killing variant).

The mines may be installed in pairs or in a row. In these cases the mines are distributed along an axis perpendicular to the probable route of the enemy tanks.

When the mines are installed in pairs a remote metal pressure-friction firing device is used (4 kilograms), which is positioned between the mines and is connected to them with pieces of demolition cord up to 1.5 meters in length.

The 1956 model mine (Fig. 51) is a tank killing mine designed for modern tanks. This mine, however, may also be used to disable tank tracks.

The mine has a metal body. The gross weight is 3.2 kilograms, the explosive charge weighs one kilogram (a mixture of 40% trinitrotoluene and 60% hexogen). The mine has a diameter of 110 mm and a height of 195 mm. It is armed with a contact pin fuze. This fuze simultaneously serves as a source of electric current necessary to set off the electric detonator. The fuze consists of a magnetic anchor, pole clips and the stator coil, a firing pin spring, the body and other parts.

For the purpose of ensuring contact between the mine and the tank a 105 cm long pin is screwed vertically to the upper fuze cap.

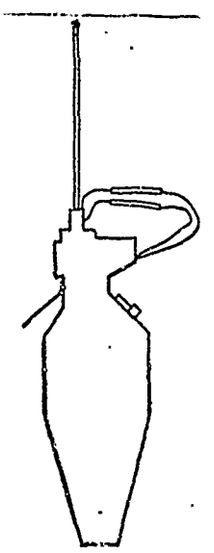

Fig. 51. 1956 model antitank cumulative mine.

Several models of antitank mines have been designed and tested during the past several years in Italy. For the most part they are non-metallic mines (wooden bodies). These mines include tank killing and tank stopping mines. All the mines are of the pressure action type.

The CS-42 mine has a wooden body of a rectangular shape. This is a tank stopping mine filled with trinitrotoluene (25 blocks 200 grams each). SC-42, CS-42/2 and CS-42/3 mines have also been produced. These mines with five kilogram charges, have different dimensions: lengths of 286, 340 and 285 mm correspondingly; width 236, 290 and 235 mm and heights of 160,160 and 145 mm.

Four pressure action fuzes are installed in the mine. The fuze housing and the pressure cap are made out of plastic. The pressure required to detonate the fuze and the mine is around 100 kilograms.

Two types of the G-50 mine are produced: types A and B. These two types are of different weight and dimensions (see table given below).

	G-50 (type A)	G-50 (type B)
Gross weight, kilograms	7.4	15.0
Weight of explosive charge, kilograms	4.0	9.00
Diameter, mm	224	287
Height, mm	200	370

The pressure required to detonate the mine fluctuates between 150 and 180 kilograms. The mine has a plastic body.

For use as a tank killing mine it is equipped with a series of remote action pressure firing devices connected to each other. Such devices are called feelers (Fig. 52), which, just like the mines, are adapted for installation in an antidisturbance position.

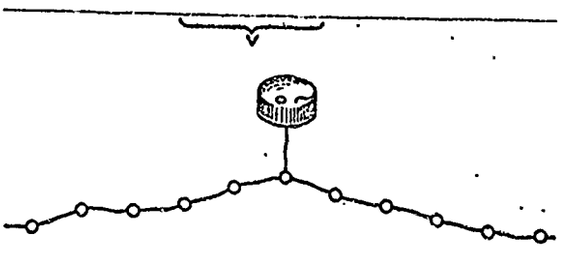

Fig. 52. The G-50 antitank mine with feelers.

In the opinion of the Italians, the four meter long feelers secured to each mine make the G-50 minefields significantly more effective than minefields consisting of conventional pressure action mines.

The SACi tank killing mine has a plastic body. The initial variant had a diameter of 280 mm and is 100 mm high. The gross weight is six kilograms, while the explosive charge weighs five kilograms.

A modernized version of this mine weighs 6.8 kilograms, while the explosive charge weighs 6 kilograms. The pressure necessary to detonate the mine has also been increased from 80-120 kilograms (in the initial variant) to 120-180 kilograms (in the second variant).

The mine may be armed with three pressure action fuzes that are screwed into the appropriate wells, or with one antidisturbance fuze screwed into the central well. All the fuzes are made out of plastic.

The SH55 mine (Fig. 53) was designed in accordance with the performance characteristics stipulated by NATO for antitank mines. This is a tank stopping mine. The body is made out of plastic, is cylindrical in shape and consists of two halves joined together. The mine contains bottom and side secondary wells for installing the mine in antidisturbance position.

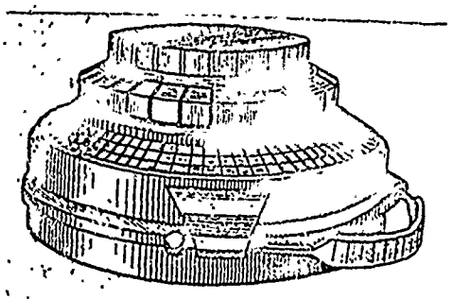

Fig. 53. The SH55 antitank mine

A special pressure action pneumatic fuze is used in the mine. Parts of that fuze are made out of plastic. The fuze has a diameter of 150 mm, its height with the detonator is 80 mm, and 65 mm without the detonator.

The mine has a high resistance against blasts, good mechanical strength, is hermetically sealed and is difficult to detect.

The mine weighing a total of 7.3 kilograms has a 5.5 kilogram explosive charge. The diameter of the mine is 280 mm, the diameter of the pressure plate is 180 mm. With the fuze the mine is 135 mm high, without the fuze -- 85 mm. The pressure required to detonate the mine (at an air temperature of 15°) is 190-210 kilograms.

The IMAC mine comes in three types differing from each other by the weight of the charge and dimensions of the body. There are the IMAC-5 (explosive charge of about 5.5 kilograms), IMAC-7 (explosive charge of about 7 kilograms) and IMAC-10 (explosive charge of about 10 kilograms).

The mine was developed in accordance with the performance

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characteristics specified by NATO for antitank mines.

This is a tank stopping mine made out of plastic. The IMAC mine is very strong and stable in high temperatures.

The mine contains base and secondary wells for installation in an antidisturbance position.

Two types of pressure action fuzes are used in the mines. Both fuzes are highly resistant to the effects of blasts. They cannot be set off by sweeping with a scorpion exploder. One of the fuzes may be set to go off on the first, second, third or fourth application of pressure on it.

Antipersonnel Mines

In evaluating the tendency inherent in the development of antipersonnel mines on the basis of data contained in the foreign press it is evident that their significance has faded, but, despite that, however, the development and introduction of antipersonnel mines still occupies the forces of all capitalist countries.

According to some of the literature, for instance, it is recommended to install antipersonnel mines in front of antitank minefields for the purpose of complicating the approach to and reconnaissance and clearing of the antitank minefields. Antipersonnel mines are also installed in clusters of a minefield in combination with an antitank mine, or independently. Antipersonnel mines are also installed on roads and elsewhere.

There are still two main types of antipersonnel mines -- explosive and fragmentation mines.

Antipersonnel explosive mines containing charges of 200 grams and more were used in World War II, whereas at the present time a charge weighing from 50 to 100 grams is considered adequate to immobilize enemy soldiers. The development of antipersonnel mines is marked by a tendency to decrease the weight of the explosive charge while at the same time increasing its shattering effect, i.e. trinitrotoluene has been replaced with mixtures of trinitrotoluene with tetryl, PETN and hexogen. The bodies of most of the mines are made out of plastics. Particular attention is devoted to the dimensions of the mine. Small height and circular shape make the mine difficult to spot and convenient to install from an armored personnel carrier. Modern mines require a pressure of from five to fifteen kilograms to set them off and are pressure action mines.

Explosive action mines are installed on or in the ground. In the latter case they are positioned so that the pressure plate or the fuze pin would be flush with the ground or would protrude slightly above the surface.

The American M14 and M25 blast action antipersonnel mines, as well as the French 1951 and 1959 models of antipersonnel mines, the British No. 6 Mk1 and the German (Federal Republic of Germany) DM11 mine are the most widely used mines.

The M14 mine (Fig. 54) consists of a cylindrical plastic body, a plastic pressure plate, an explosive charge, a special fuze and a

safety clip. This mine has been in use in the US Army since 1953. The mine weighs 127 grams, its explosive charge weighs 31 grams. The body is 40 mm high and has a diameter of 55 mm. The pressure required to set off the mine varies between 9 and 16 kilograms.

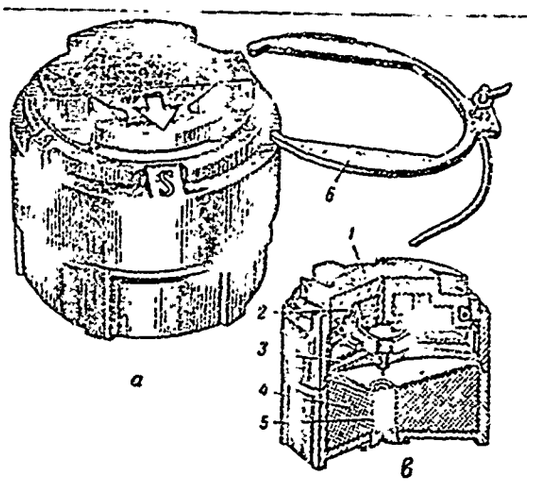

Fig. 54. The M14 antipersonnel mine

Legend: A -- Overall view; B -- Cross section; 1 -- Pressure plate; 2 -- Lock key; 3 -- Belleville spring; 4 -- Main explosive charge; 5 -- Detonator; 6 -- Safety cup.

The M25 mine (Fig. 55) consists of a plastic body, a shaped explosive charge, a firing mechanism and a safety device consisting of two elements -- a pin and a stopper which simultaneously protects against dust.

The fuze in the mine with striker-retainers that roll out, is set off by a pressure of 7.5-10 kilograms.

The mine weighs 93.5 grams, the explosive charge (trinitrotoluene) weighs 8.5 grams. This mine has a diameter of 28.5 mm and is 92 mm high.

The blast injures the soldier's leg. The mine pierces a hole 12 mm in diameter in a 10 mm thick steel plate.

The 1959 model of the antipersonnel mine has a plastic body. The fuze is of the friction type. The mine weighs 135 grams, the explosive charge (trinitrotoluene) weighs 55 grams, the detonator weighs 15 grams. The mine has a diameter of 60 mm, it is 32 mm high and requires a pressure of 5-15 kilograms for detonation.

The 1951 model of the Mi.AP.1D. M1e51 mine (Fig. 56) is made of plastic with a diameter of 70 mm and a height of 52 mm. The mine weighs 85 grams and the explosive charge weighs 45 grams. It contains

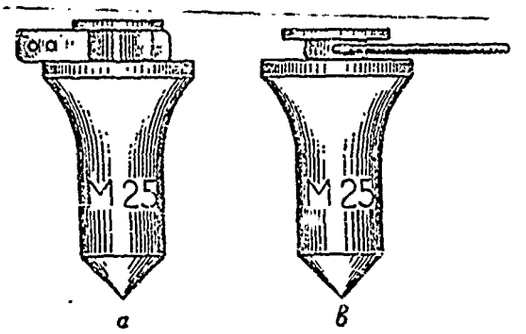

Fig. 55. The Mat ntipersonnel mine.

Legend: A -- Armed mine with safety pin; B -- Mine ready for transportation (the lid is installed instead of the explosive charge).

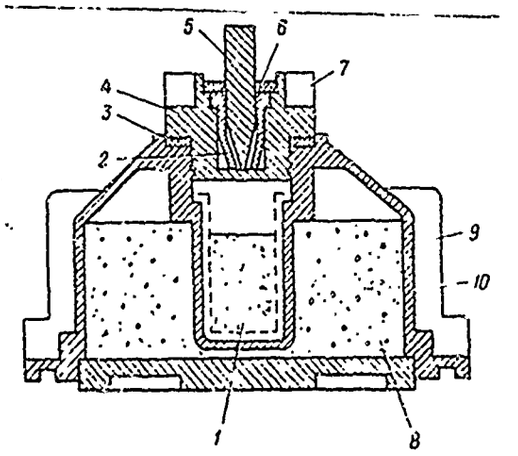

Fig. 56. The Mi.Ap.ID. Mle51 antipersonnel mine (1951 model).

Legend: 1 -- Detonator; 2 -- Sleeve with the friction compound; 3 -- Gasket; 4 -- Coupling base; 5 -- Firing pin; 6 -- Shear collar; 7 -- Fuze housing reinforcing ring; 8 -- Explosive charge; 9 -- Mine body reinforcing rib; 10 -- Plastic body.

a friction fuze. The mine requires a pressure of 10 kilograms for detonation. The mine cannot be detected by an induction mine detector.

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The No. 6 Mk1 mine (Fig. 57) has a plastic body. The mine weighs 227 grams, its explosive charge weighs 142 grams. It is 203 mm high when assembled. The body has a diameter of 45 mm.

The DM11 mine consists of a body, an exterior rubber cover, an explosive charge, a detonator, a firing mechanism and a safety ring.

The mine is resistant to the effects of blasts and is made out of plastic and other non-metallic materials. It is usually installed on top of the ground, and sometimes in mine holes.

The mine weighs around 200 grams, its explosive charge (trinitrotoluene) weighs 100 or 45 grams. The mine has a diameter of 80 mm. With the fuze it is 35 mm high. The pressure necessary to detonate the mine (pressure applied to its edge) is 10 kilograms.

Antipersonnel fragmentation mines whose bodies are made, as before, out of steel, find widespread use under present day conditions. The tendency to increase the action radius (range) of the fragments is noticed in the use of such high explosives as PETN and hexogen. The weight of the explosive charge usually varies from 0.2 to 0.4 kilograms.

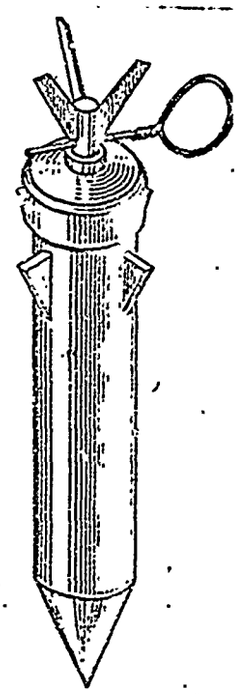

Fig. 57. The No. 6 Mk1 antipersonnel mine.

Fragmentation mines both of World War II and of the postwar vintage, are divided into bounding mines installed in the ground and blast-fragmentation mines that are installed on the surface of the ground. Directional mines of the American M18 "Claymore" type are included in the above group.

Bounding mines of all the foreign armies have a killing element consisting of an explosive charge and fragmentation material. The latter may consist of small balls, pieces of metal, or come in the form of a metal body that is shattered by the blast. The killing element is ejected by powder gases up to a height of 0.5-1.5 meters where it explodes killing enemy troops within the range of the fragments. The action radius, depending on the type of killing element, may amount to 30 meters, while some of the fragments are scattered up to a distance of 150-200 meters.

The group of bounding mines includes American M2A1 and M16 mines, the British Mk-2 mine, the French 1951 model mine, the Italian AUS 50/5 mine, and the West German DM31 mine.

The group of blast-fragmentation mines includes the American M3 and M18 "Claymore" mines, and the British No. 5 Mk1 and No. 8 Mk1 mines.

The M2A1 mine (Fig. 58) consists of a projector tube, a projectile, a killing element, a propelling charge, a fuze, and an explosive train.

The killing element with an explosive charge consists of a steel body of a 60 mm mortar shell with a steel sleeve mounted on top that increases the fragmentation effect of the mine.

The mine is installed with pull action or a combination fuze (pull and pressure action).

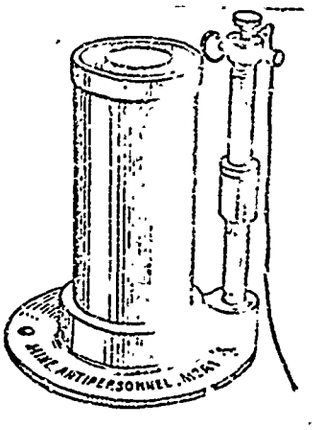

Fig. 58. The M2A1 antipersonnel mine.

The mine weighs about 2.5 kilograms, while the killing element weighs 900 grams and the charge weighs 160-180 grams. The diameter of the mine at the base is 132 mm, while the diameter of the projectile is 63 mm. The mine is 162 mm high. The killing element is propelled to a height of 1.5-2 meters above the ground. The casualty range is 5-9 meters, while the fragments are scattered over a distance of up to 120 meters. The force required to detonate the mine is nine kilograms for pressure action fuze and 1.5-3 kilograms for the pull action fuze.

The later modifications of the mine (M2A2, M2A3 and M2A4) differ little from the original M2A1 mine.

The M16 mine (Fig. 59) was introduced in 1953 and consists of an outer and inner casing, a cast iron lid, an explosive charge, a fuze and detonators with delay elements.

The M605 fuze (Fig. 60) is of combined action (pressure and pull action).

The mine (without the fuze) weighs 3.5 kilograms, the explosive charge weighs 454 grams. The mine has a diameter of 103 mm, the outside body is 120 mm high, with the fuze the mine is about 200 mm high. The mine detonates 0.6-1.2 meters above the ground. The casualty range is 20 meters. The force necessary to set off the mine is 3.5-10 kilograms for pressure action and 1.4-4.0 kilograms for pull action.

The Mk2 mine (Fig. 61) consists of a cylindrical shell with a tongue, a cast iron case and a steel projectile case, a pull action firing device, a fuze with a release lever, and an ejection and explosion charges. The mine weighs 4.5 kilograms, the charge weighs 450 grams, the diameter of the mine is 90 mm. It is 140 mm high (without the fuze). The mine explodes 1.5 meters above the surface of the ground. The casualty range is 25 meters, the fragments cover

a distance of up to 200 meters.

The 1951 model mine consists of an outer case, a canister, and a pull action fuze. The mine weighs 4 kilograms, the explosive charge weighs 0.4 kilograms. The mine has a diameter of 100 mm. It is 160 mm high (without the fuze), the mine explodes 0.8 meters above the surface of the ground. The casualty range is 50 meters, and a pull of 1.2-3.5 kilograms is necessary to detonate the mine.

The 1948 model antipersonnel mine is a prototype of the 1951 model mine. The 1948 model in external appearance resembles the 1951 model mine, in almost all details.

The AUS 50/5 mine consists of a body with a diaphragm, a lid, the bursting element, the propelling and detonation charges, a fuze and delay elements.

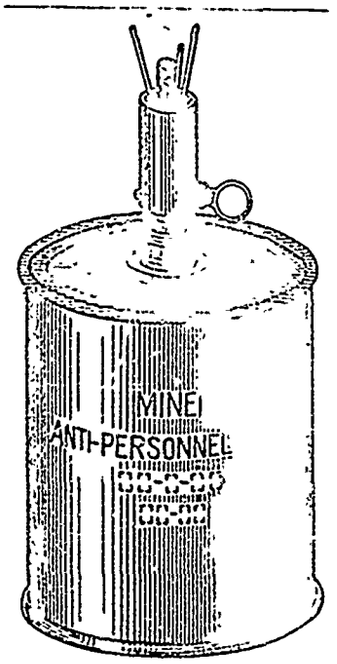

Fig. 59. The M16 antipersonnel mine.

The body, lid and the fuze are made out of plastic. The body is in the form of a cone and is strengthened with reinforcing ribs. The bursting element is a massive ring consisting of 0.5 mm steel balls filled with mortar.

The detonation charge (substance B) is of a special shape in order to obtain a cumulative effect (shaped charge effect) on explosion. The fuze is of the combination type -- pressure and pull action. The force necessary to detonate the mine by pressure may be varied which is accomplished by the installation of a shear collar of varying thickness into the fuze.

The mine weighs 1.7 kilograms, the charge weighs 150 grams. The diameter of the mine is 125 mm and it is 140 mm high with the fuze. The bursting element is ejected to a height of 0.5 meters, the casualty range is 15 meters.

The DM31 mine is made of metal and consists of a body, a killing element, a detonation and ejection charge and a pull action fuze. The mine is hermetically sealed and is installed in the ground. The mine weighs four kilograms, the detonation charge (trinitrotoluene) weighs 550 grams, the body has a diameter of 125 mm. The mine is 102 mm high. The casualty range is up to 100 meters. This mine is a prototype of the Smi-35 mine used in World War II.

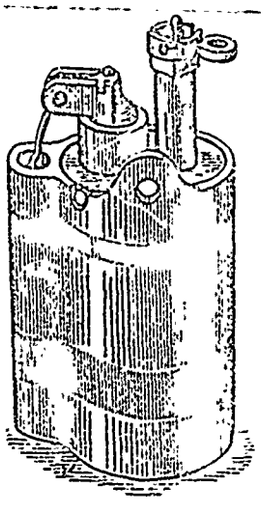

Fig. 61. The Mk2 antitank mine

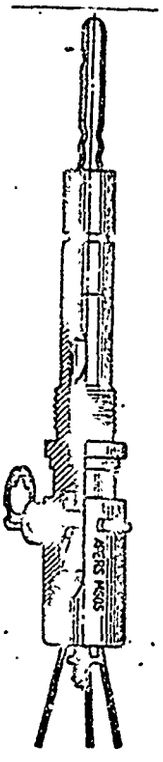

Fig. 60. The M605 fuze for the M16 mine.

The M3 mine (Fig. 62) consists of a cast iron prismatic body, an explosive charge and from one to three combination fuzes (pressure and pull action). The mine is installed in the ground or on its surface.

The mine weighs 4.2 kilograms, the body weighs 3.8 kilograms, the explosive charge weighs 0.4 kilograms. The width and length of the mine is equal to 87 mm. It is 135 mm high. The walls of its body are 10-11 mm thick. The casualty range is 15 meters. The force necessary to detonate the mine is: pressure action -- 6-15 kilograms, pull action -- 1.5-2.7 kilograms.

The M18 "Claymore" mine (Fig. 63) is a directional fragmentation mine.

The main parts of the mine consist of: the body, the explosive charge, three props, a sighting and detonating device.

The mine body has the shape of a convex prism. A metal plate is in the front part of the mine. This plate produces the fragments. The lower part of the body contains two primer wells and three wire props used to support the mine. For convenience of installation at any angle the props are hinged. The sighting device is used to point the mine at the target (orientation of the mine on the terrain). The detonating device includes an electric detonator, the ends of two 15 meter long pieces of wire and two flashlight batteries

(not less than three volts).

The mine is covered with a green fabric with the ends on each side serving to secure the mine to various objects.

The different elements used with the mine are distributed in a container of the chest bandolier type.

The M18 mine is most effective if it is pointed at a target or aimed.

This mine may be detonated by the electrical or mechanical method using pull action fuzes.

The mine may be detonated by an operator concealed in a shelter, upon the approach of the enemy. Upon explosion a directional blast of fragments forms scattering in a fan like pattern.

The mine may also be used as a booby trap with pressure action fuzes. This mine weighs about one kilogram (about 1.5 kilograms in its shipping container). The mine is 120 mm high when rigged for transportation, it is 215 mm high when installed on the props. The mine is 225 mm wide, and 25 mm thick.

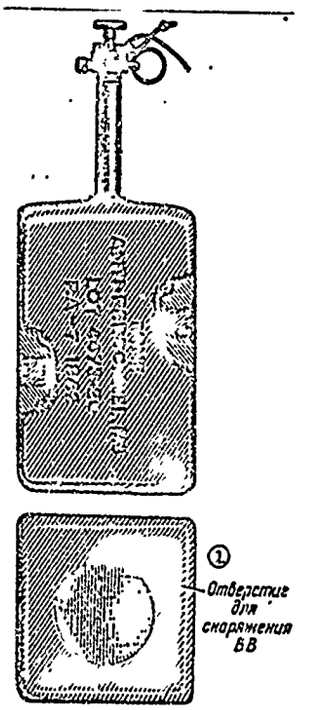

Fig. 62. The M3 antipersonnel mine.
Legend: 1 -- Opening for the explosive charge.

There is information that the M18 mine will soon be replaced with the M18A1 mine, which is ready for serial production. The new model of the mine has fewer component parts, a simpler design and a greater margin of reliability without a decrease in its reliability. At a distance of 30 meters from the mine the fragmentation pattern is 30 meters wide and two meters high.

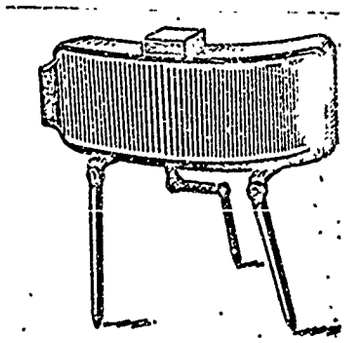

Fig. 63. The M18 "Claymore" antipersonnel mine.

The No. 5 Mk1 mine (Fig.64) consists of a tin cylindrical body, an explosive charge, a special pressure action fuze and a pressure pedal.

The mine is installed in the ground. The No. 5 Mk1 mine weighs 230 grams, the explosive charge

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weighs 190 grams, its diameter is 50 mm. The mine is 90 mm high (with the pressure pedal). The pressure required to detonate the mine is 2.7 kilograms.

Mine No. 8 Mk1 kills with a bullet that is fired when the mine is detonated. The mine consists of a cylindrical body with a pressure plate, a firing pin and a live cartridge. The mine is installed by inserting the pointed part of the body into the ground. The mine weighs 170 grams, it has a diameter of 13 mm and is 146 mm high. The pressure required to detonate the mine is 10-12 kilograms.

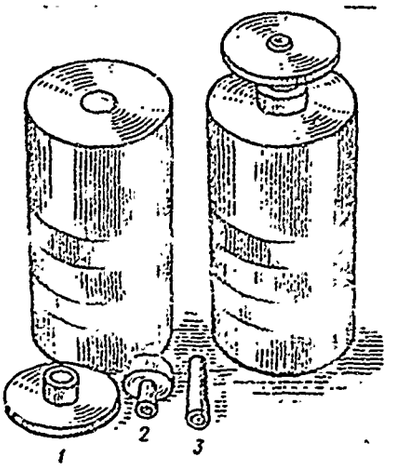

Fig. 64. The No. 5 Mk1 antipersonnel mine.
Legend: 1 -- Pressure plate;
2 -- Fuze with a collar;
3 -- Detonator.

Mining Methods and Techniques

The US Army command has recently been pushing its theory of "mine warfare" off on NATO, the basis of which is the "standard" American minefield pattern. (Fig. 65).

According to the Americans the minefield must be installed covertly within the antitank fire and defense system.

The minefield usually consists of three strips of mines and a front "disordered" row. The purpose of such a row is to complicate the search for the minefield boundary.

Each strip of mines consists of two rows of mine clusters which are distributed on the terrain parallel to each other at a distance of three paces along the mining front (line), alternately to the right and to the left.

The cluster (Fig. 66) is the basic unit of the minefield and has the form of a semicircle with a radius of two paces. Either one antitank mine or one antipersonnel mine is installed in the cluster, or one antitank mine and several antipersonnel mines (no more than four) or several antipersonnel mines (no more than five).

The antipersonnel or antitank mine is in all cases installed at the center of the cluster.

When installing mines in clusters the antipersonnel mines are installed without any system, but they must not extend beyond the radius of the cluster.

The installation of individual pull action mines in the minefield is authorized. In that case only one pull action mine is in-

stalled in each cluster, and the trip wire is located no closer than two paces from the neighboring mine.

The distance between strips, measured from its central line is 15 meters (18 paces). This distance, however, just as the distance between the clusters, may be varied depending on terrain conditions.

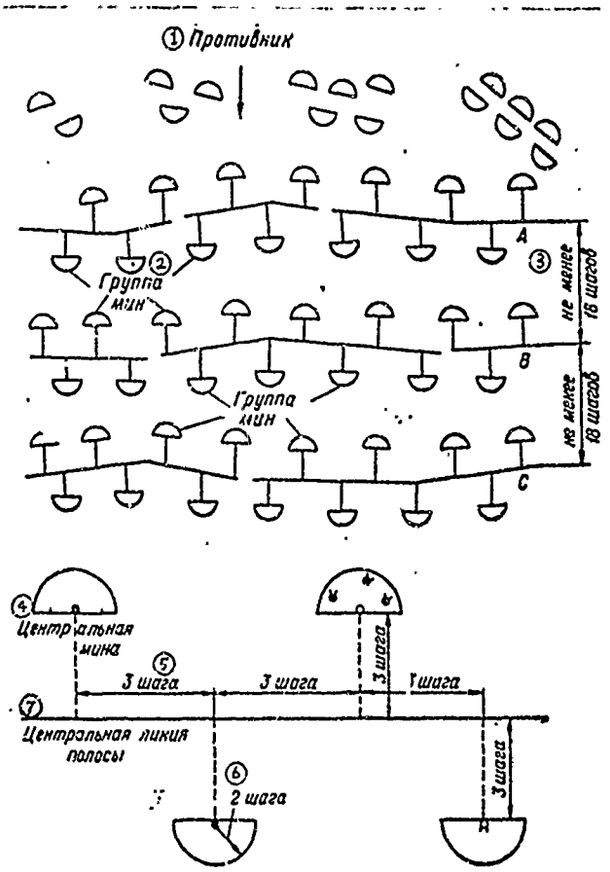

Fig. 65. Standard minefield pattern.

Legend: A, B, C -- Strips of mines; 1 -- Enemy; 2 -- Cluster of mines; 3 -- Not less than 18 paces; 4 -- Base mine; 5 -- 3 paces; 6 -- 2 paces; 7 -- Center line of strip.

The strips of mines on the terrain are broken and are not parallel to each other.

When changing the direction of the strip of mines on the terrain the last cluster is situated before the curve, while the first cluster after the curve (break) is located three paces past the break in the central line.

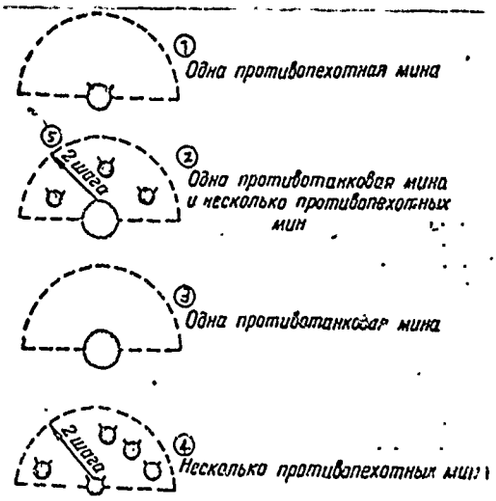

Fig. 66. The cluster of a standard minefield.

Legend: 1 -- One antitank mine; 2 -- One antitank mine and several antipersonnel mines; 3 -- One antitank mine; 4 -- Several antipersonnel mines; 5 -- 2 paces.

The mines installed in front of the forward minefield boundary are scattered but the cluster, as the basis, remains in this case as well. The number of clusters usually amounts to 1/3 of the normal mine strip and the mines are more sparse than in the normal strips.

The minefield density, i.e. the number of mines per pace along the front of the minefield varies and is designated by figures. For instance, 1-2-0 or 3-1-1 indicates the number of antitank, antipersonnel and boundary mines. In order to create the desired density per pace along the minefield front, these figures are multiplied by three (the distance between clusters).

The number of mines obtained in this manner is used to determine the composition of the mine cluster for each individual strip.

Example. The assigned minefield density -- 1-3-1.

	ATM	APM	Bounding mines
Assigned density	1	3	1
multiplied by 3	3	9	3
Strip A	1	2	0
Strip B	1	2	1
Strip C	1	2	1
Strip D	0	3	1

This number of mines is installed in the clusters of each strip. Possible methods of installing antipersonnel mines on the terrain are shown in figures 67-69.

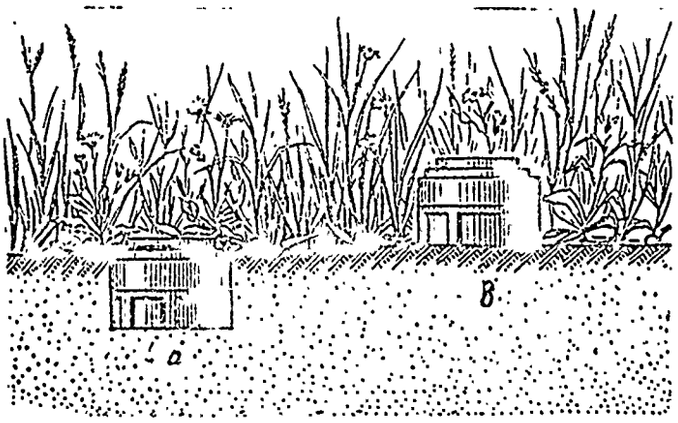

Fig. 67. Installation of an antipersonnel mine.
Legend: A -- Into the ground; B -- On the ground.

Fig. 68. Installation of an antipersonnel mine on swampy terrain.

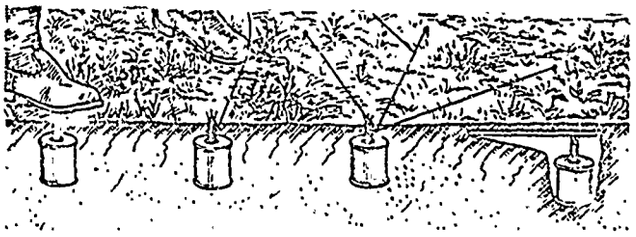

Fig. 69. The installation of antipersonnel fragmentation (bounding) mines.

The plan for the standardization of mines is being worked out for the purpose of elaborating a set of antitank and antipersonnel mines standard to all the armies of the NATO block. It is planned to include three types of antitank mines, and two to four types of antipersonnel mines per set.

This type of set exists in certain European armies. The French army set, for instance, includes 40 antitank and 10 antipersonnel mines. The number of sets varies in the different units: an infantry battalion has 10 sets, an infantry division combat engineer battalion has 12, while a combat battalion of an armored division has 24 sets.

A standardized mandatory system of signs (Supplement 4) is being introduced in NATO armies for the designation of mine fields on maps and on the terrain, as well as for the designation of lanes and gaps (Fig. 70).

A record is prepared for each installed minefield which must indicate the date the minefield was installed, the appearance and position of the main and the intermediary reference points, the number of mine strips, the number and type of installed mines as well as data on the antidisturbance mines.

The sketch of the minefield and the auxiliary planometric material on the terrain (not in scale) give the position and number of reference points, the distance and direction in meters and according to the compas from the reference points to the strips of mines, the position of the center line, and length and direction of the mine strip.

The principal means of carrying out accelerated installation antitank mines are the trailer type mine layers and mine laying vehicles. The latest model of a mine layer is a model produced by the firm "Dan Patch" (Fig. 71) which consists of a magazine, a feeder mechanism, a mechanism for the installation of mines, a plow and a chassis. The mine layer transports the mines in a magazine which feeds them automatically to the installation mechanism during the mining operation. When engaged in mining the mine layer is transported by a crawler tractor. The plow slices the sod and digs

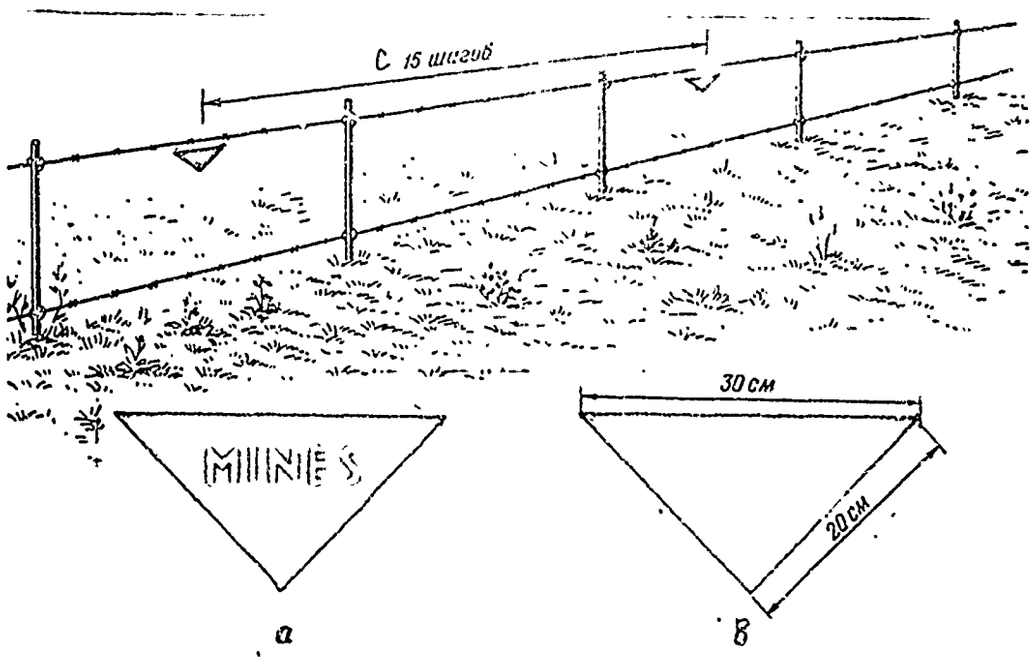

Fig. 70. Designation of lanes in the US Army.
Legend: A -- Front of sign; B -- Back of sign; C -- 15 paces.

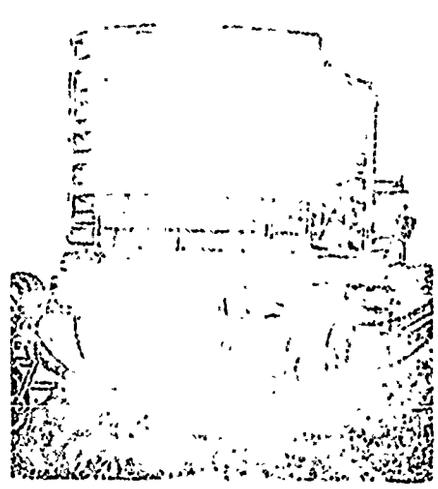

Fig. 71. A mine layer.

a ditch into which the mines are automatically placed. The ditches are then covered and camouflaged.

Such a mine layer is capable of installing 150 antitank mines in ten minutes. The mine spacing is either four or six yards.

It is believed, however, that mine layers cannot always install a large minefield since this involves a great variety of difficulties pertaining to material-technical supply (logistics).

In this connection great significance is attributed to the installation of minefields from helicopters.

The Americans consider one of the advantages of minefield laying by helicopters to be the absence of revealing tracks or the disturbance of the ground cover; speed with which the mines may be installed; an increase in the possibility of selecting various minefield sites; a decrease in the number of personnel required for mining operation; and greater protection against radio-active contamination during operations in zones that were subjected to nuclear attack.

CHAPTER VI

MEANS AND METHODS OF RECONNOITERING MINED OBSTACLES

The initial step in breaching mined obstacles installed by the enemy consists of a reconnaissance of the obstacles which is carried out by a line unit or by a specially assigned engineering reconnaissance patrol.

The reconnaissance of obstacles must determine the location of the obstacles, the depth and width of the front occupied by the obstacles, the extent of obstructions, the location and types of high explosives, the lay out of the minefields, the type of mines that were installed, etc.

It is necessary to reconnoiter the way in which the enemy is defending the obstacles, the location of his weapon emplacements, the strength of the units defending the obstacles; it is necessary to probe for weak spots in the obstacles along with possible bypasses.

When reconnoitering mine obstacles the combat engineer must know how to quickly distinguish evidences of each type of obstacle paying attention to each detail and suspicious factor.

Nothing must escape the combat engineer's alert eye: uneven features on the surface of the ground, fresh tracks, wires, or string protruding from the ground, any tools or other objects lying around --- everything must be examined. Suspicious spots should be probed with a mine detector or a probe.

When reconnoitering buildings abandoned by the enemy it is necessary to thoroughly investigate all approaches to them, then, the door should be opened with the aid of a hook secured to a rope (a drag) or a pole. After that the stairs, the floor, the condition and uniformity of the plaster, stove and wall brickwork should be checked. On entering the building and without moving anything it is necessary to carefully examine all objects, to check the electrical wiring and to find out its purpose. It is also necessary to determine the source and purpose of each suspiciously protruding piece of rope or wire.

It is necessary to attentively watch for signs left by the

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enemy on the fences, buildings, telegraph poles and so on, and to try to decipher them. Any standard signs or flags that are found may facilitate the location of any mined obstacles left by the enemy.

The engineering reconnaissance of mined obstacles must be continuous and mobile for which purpose it is necessary to assign special observers who must note all the changes in enemy activities. In addition to that it is important to dispatch special engineering reconnaissance patrols at regular intervals, or to include combat engineers with specifically engineering assignments in regular reconnaissance patrols.

The combat engineers, depending on the mission, must have: a mine detector, a probe, a knife, wire cutters or flatnose cutting pliers, safety pins or pieces of wire 40-50 mm long and of varying thickness, thin rope (or binder twine and a conductor) 30-40 meters long with a small grapnel or a hook, 200 gram trinitrotoluene blasting cartridges, fuzes, matches, friction tape along with other necessary materials.

Set of Equipment for Reconnaissance and Demining

A special bag for the mine and demolition man along with a set of equipment for reconnaissance and demining have been designed for the convenience of combat engineer scouts.

The bag is an elongated rectangular box sewn out of two layers of canvas pasted to cardboard. The bag has four compartments of equal size and it may be carried either by a belt strapped over the shoulder or on the uniform belt.

The bag contains a minimum of materials and tools necessary for mining and mine clearing operations, including explosives and detonation devices.

The set of equipment for reconnaissance and mine clearing operations includes sectional probes, grapnels with ropes up to 30 meters in length, flags, reels with black-white tape, and wire cutters. All these items are packed in a special box. The loaded box weighs around 50 kilograms.

The sectional probe (Fig. 73) consists of a pointed steel tip 310 mm in length and 5 mm in diameter and a handle, consisting of three separate sections. The overall length of the assembled handle is 146 cm, and 177 cm with the tip attached.

For work in the standing position the probe is assembled out of three sections, and the tip is attached in line with the handle.

For work in the prone position the probe is assembled out of one (first) section and the tip is installed at a 30° angle to the handle. The tip of the third section is screwed along the outside threading at the blunt end of the tip. The probe is secured to the wrist with a cord passed through a hole in the top section.

When working in the standing position the probe handle is tilted at a 20°-45° angle to the surface of the surface of the ground. The ground is probed smoothly to a depth of 10-15 cm every 10-20 cm in order not to miss a mine.

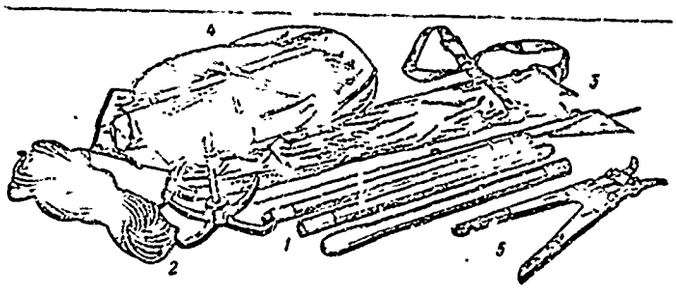

Fig. 72. Set of equipment for reconnaissance and demining.

Legend: 1 -- Sectional probe; 2 -- Grapnel with four claws; 3 -- Flags; 4 -- Black and white tape; 5 -- Barbed wire cutters.

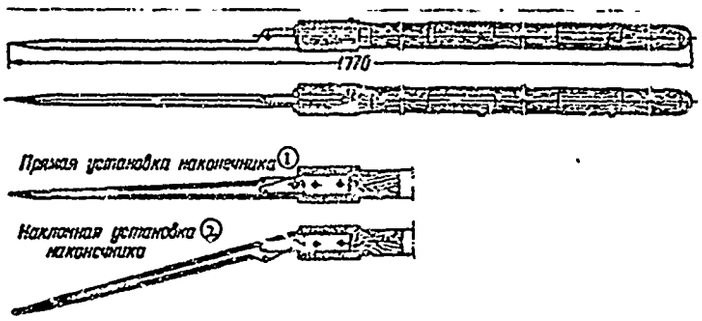

Fig. 73. The sectional probe.

Legend: 1 -- Tip installed in line with the handle; 2 -- Tip installed at an angle to the handle.

If the probe touches a solid object during the probing operation, that spot is carefully examined and marked with a flag or some other marker.

The grapnel with four claws secured to a rope 30 meters long is used to extract (move) the detected mines, for reconnaissance and the destruction of pull action antipersonnel mines as well as for moving suspicious objects.

To move a mine from the point where it was installed the grapnel is hooked to its safest part and carefully moved from a distance of 30 meters from behind a shelter, or from the prone position.

For the reconnaissance or destruction of pull action antipersonnel mines the grapnel is held in the hand so that the claws (flukes) are pressed against the shaft but not tightened with a nut. When tossing the grapnel the claws (flukes) open up and then when it is pulled back with the rope they hook the mine trip wire.

The flags serve to designate mines that are found and left in place. The flags are made of metal, painted red and marked with a white letter "M".

The poles are metal and have two clamps for additional poles in order to increase the height of the flag pole when used in tall vegetation. The flags are stored and transported in packs of 10 in canvas bags.

The black and white tape which is 100 meters long is made out of cotton fabric and is designed to mark the boundaries of the lane through minefields. The black and white strips on the tape are 0.5 meters long each. Every five meters the tape is marked with figures 5, 10, 15, 20 and so on, corresponding to the distance from the beginning of the tape.

The tape is wound on a special reel which is secured to a soldier's belt when in use. One end of the tape is secured to the ground with a pin. The tape unreels as the soldiers move away.

A combat engineer's drill, a depth probe, steel drills and jumpers, chisels, small crowbars-nail removers, wooden hammers, light filters, magnifying glasses and other auxiliary tools are used for the reconnaissance and detection of delayed action mines which are most frequently installed in walls and basements of public buildings and dwellings, along railroad lines and highways, and in industrial enterprises.

The combat engineer's drill (Fig. 74) is designed for drilling

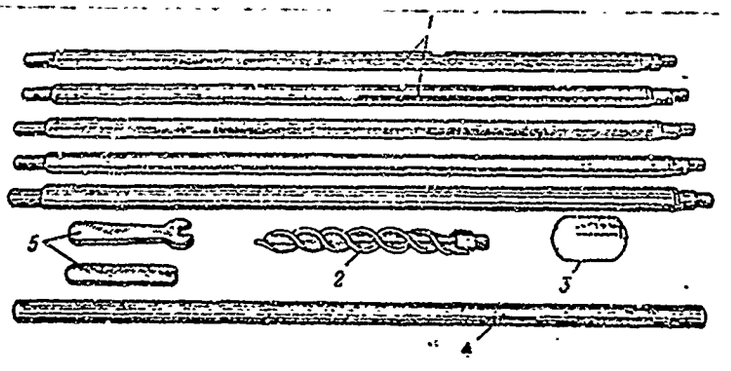

Fig. 74. The combat engineer's drill

Legend: 1 -- Shaft sections; 2 -- Bit; 3 -- Brace; 4 — Tap wrench; 5 — Wrenches.

of holes in the ground to a depth of five meters with a diameter of 35 mm. The drilling rate with two men is about three meters an hour.

The drill set includes either a spoon or a twist bit (the set contains both types), five shaft sections 25 cm in diameter and one meter long, a tap wrench head and a tap wrench. The drill is assembled with the aid of two wrenches. The drill weighs 6.5 kilograms.

As the drill is sunk into the ground it is periodically removed and cleaned of dirt. As the hole deepens additional rods are secured to the drill, and the tap wrench brace and the tap wrench are moved to the added rod.

The depth probe (Fig. 75) is designed for probing natural ground (that has not been turned over) to a depth of two meters, and loose ground to (filled in holes and wells) to a depth of 3.5 meters. The depth probe consists of a steel rod 8 mm in diameter consisting of six one meter sections. The ends of the rods are threaded and are joined with the aid of sleeves. A conical tip is screwed to the bottom section.

The overall weight of the probe (in its holster) is 4.5 kilograms.

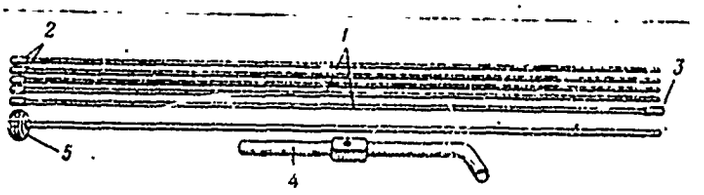

Fig. 75. Depth probe.

Legend: 1 -- Rod sections; 2 -- Sleeves; 3 -- Tip; 4 -- Tap wrench; 5 -- Stethoscope.

It is feasible to use the depth probe in conjunction with the combat engineer's drill, introducing the probe into the hole for the purpose of determining the nature of the encountered obstacle. A clanking sound is heard when the probe is tapped on a metal object, if the object is made of wood a dull sound is heard.

A stethoscope (not included in the set) is screwed to the end of the probe for the purpose of listening to timing devices.

The chisels, drills, and jumpers are used on stone, concrete or other massive structures, while the small crowbars-nail removers are used on wooden floors and partitions.

Wooden hammers are used for tapping walls for the purpose of detecting empty spaces (chambers) in them. A dull sound is heard when an empty space in a wall is encountered which is easily distinguished from sounds produced by tapping on a solid structure.

Light filters and magnifying glasses are designed for thorough

examination of wall and ceiling surfaces, as well as other structures. Freshly painted surfaces are revealed through the light filters.

Mine detectors. Induction mine detectors are widely used in all the armies for the purpose of searching for antitank and antipersonnel mines with metal parts. The basic elements of the mine detector are: the search head, power supply-amplifier, cable linking these two elements, rods, a power supply and a set of headphones.

The mine detectors are stored and transported in special containers, which, during operation, are carried either on the back or over the shoulder.

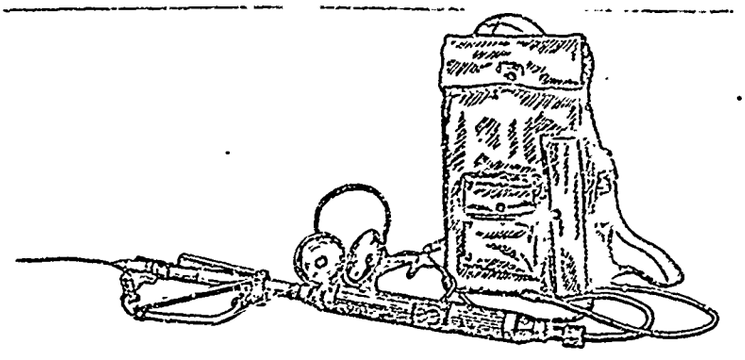

Fig. 76. A mine detector with a probe.

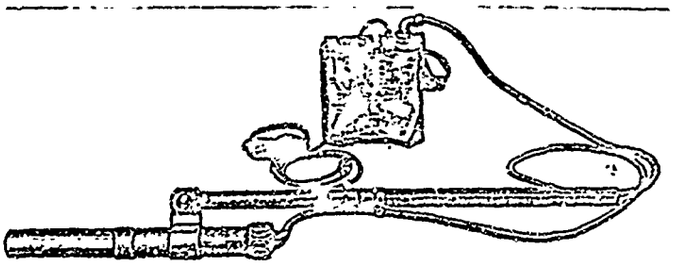

Fig. 77. A mine detector.

Before it can be used the mine detector must be assembled for which purpose the rod (rods) the power supply-amplifier, the search head, and the headphones are removed from the container connected.

The assembled mine detector (Figs. 76, 77) is tuned. When tuning the mine detector the search head is positioned at a height of 0.1-0.7 meters from the surface of the ground (there must not be any metal objects within a radius of one meter). Mine detectors operating nearby are moved away to a distance of six or more meters.

A check on whether the mine detector is properly tuned is made by bringing the search head of the mine detector to any metal object (a mine body, a shovel, etc.). If the detector is properly tuned the control tone, audible in the headphones, depending on the kind of mine detector, may drop in pitch, disappear completely or increase in volume as the search head is brought close to the metal object.

The mine detector detects the presence of metal mines in the ground, and in water up to a depth of 40 cm with complete reliability under any meteorological conditions.

Work with the mine detector requires that the mining engineer, walking in the assigned direction, moves the search head smoothly and continuously, shifting it from right to left over the surface of the ground keeping it 5-7 cm above the ground.

The width of the strip covered by the mine detector when the operator is working standing up is 1.7 meters, in the prone position the mine detector covers a strip one meter wide. The engineer moves ahead 15-20 cm after each series of passes with the detection element. It is necessary to be careful not to leave any unchecked areas.

If there is a change in the control tone in the headphones or if it has completely disappeared, the engineer must stop and determine the exact location of the detected object. For this purpose it is necessary to move the search head smoothly over the suspicious area until the greatest change in the control sound in the headphones is achieved. In this position the detected object will be directly under the search head of the mine detector.

After the location of the object is precisely determined the engineer marks the spot with a special sign (flag, peg, and the like).

In the process of the search the engineer must periodically check the tuning of the mine detector and, if necessary, re-tune it.

When working with the mine detector the engineer must pay close attention to the control sound in the headphones. This is fatiguing and decreases the attention. For this reason, depending on the mission at hand and on the situation, it is best to assign two men to mine detection work so that they could alternate in working with the mine detector.

The search for mines with a mine detector in a standing position is shown in Fig. 78, while operation of the mine detector in a lying position is shown in Fig. 79.

Fig. 80 shows a combat engineer with a mine detector prepared for underwater search.

Fig. 78. Searching for mines in a standing position

Antitank mines with a metal body are detectable at a depth of 35-40 cm, while mines with wooden or plastic bodies containing metal parts (fuze, etc.) are detectable at a depth of 10 cm.

Antipersonnel mines with wooden or plastic bodies if they contain a metal fuze, are detectable at a depth of 5-8 cm. The filament batteries in a mine detector have a life of 20-80 hours, while the anode batteries last for 80-100 hours.

Fig. 79. Searching for mines in a prone position.

The gross weight of the mine detector in its shipping container is 7-10 kilograms, while the search head weighs 1.5-2.0 kilograms.

The mine detectors may be used in temperatures of from -40° to +50°C.

The length of the search head assembled for use in a standing position is 1.4-1.7 meters, and 0.65-0.95 meters for use in a prone position.

The area that may be covered in an hour by a mine detector from a standing position varies from 200 to 350 m^2, while the area that can be covered from the prone position is about 100 m^2.

Fig. 80. A combat engineer ready to work in water.

Detector of Ferromagnetic Bodies (Bomb Detector)

The bomb detector is a magnetometric instrument designed for use in searching for aerial bombs, artillery shells and mines buried in the ground whose bodies are made out of ferromagnetic materials.

The principle elements of the bomb detector are the detection element, galvanometer-amplifier, a control panel, a power supply and a reel of cable.

The detection element is carried with the aid of two canvas straps with handles secured to the ends of the device. A black stripe is painted along the body of the device for the purpose of designating its proper position. The detection element is about two meters long, it has a diameter of 20 cm and weighs 34 kilograms.

When carrying the detection element over the surface of the ground first one and then the other coil will pass through the local distortion of the magnetic field of the earth at a point where the ferromagnetic body is located (bomb, shell). A signal is then transmitted over the cable to the control panel in the form of a smooth deviation of the meter pointer first to one and then to the other side from some initial position on the scale.

By recording the local distortion of the terrestrial magnetic field caused by the ferromagnetic body it is possible to detect the ferromagnetic body in the ground (bomb, shell, mine).

Fundamental Operational Characteristics of the Bomb Detector

Depth at which FAB-50 aerial bomb may be detected in the ground	up to 4.2 meters
Area covered in eight hours on dry ground	0.3-0.5 hectare
Area covered in eight hours under water	up to 0.2 hectare
Maximum permissible search depth for undetonated mines, shells or bombs under water	15 meters
Life of power supply (continuous use)	50 hours
Bomb detector operating crew	6 men (including crew commander and operator who are specially trained)
Gross weight of bomb detector set in shipping crates	190 kilograms

The procedure of searching for explosives on the terrain (dry land) with the aid of the bomb detector are demonstrated in Fig. 81, while the position of the bomb detector during the search is shown in Fig. 82.

If the zone being searched is excessively littered with fragments it is feasible to check the area with mine detectors and then remove all the metal objects before using the bomb detector. If this cannot be done it is allowed to carry the detection device "at hip level" or "over the shoulder" for the purpose of decreasing the number of false signals. When using these positions, however, it is necessary to take into account the fact that the depth at which the device will detect objects will decrease.

When engaged in a search it is categorically prohibited to walk around in the immediate vicinity of the galvanometer-amplifier and the control panel, since even slight vibration of the ground may lead to a false signal similar to that produced by a mine, shell or bomb.

In rainy weather or when it is snowing the control panel and the galvanometer-amplifier are positioned in a tent since moisture interferes with their normal operation causing the pointer of the indicating instrument to "creep" more than usual.

In order to eliminate the "creep" of the pointer the operator must readjust the bomb detector regularly, temporarily discontinuing the searching operation for that purpose.

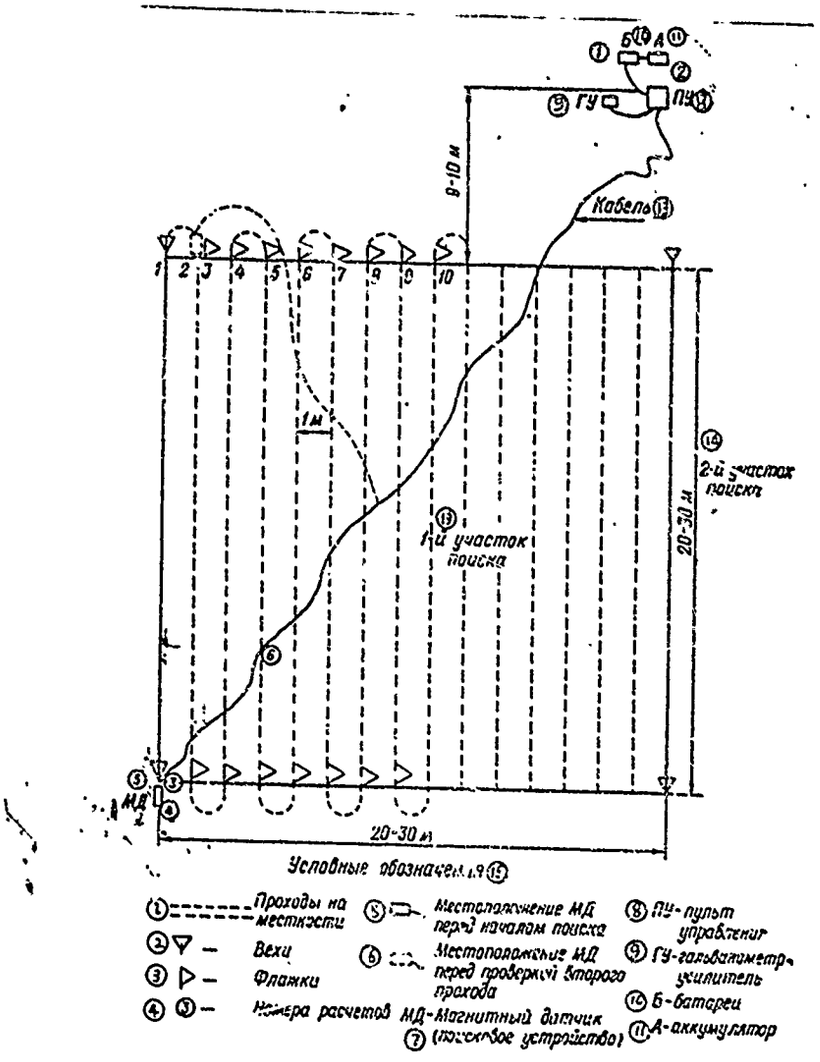

Fig. 81. Method of working with the bomb detector.

Legend: 1 — Passes over area; 2 — Markers; 3 — Flags; 4 — Numbers of crew members; 5 — Position of magnetic pickup before start of search; 6 — Position of magnetic pickup before second pass; 7 — Magnetic pickup (detecting device); 8 — Control panel; 9 — Galvanometer-amplifier; 10 — Batteries; 11 — Storage cell; 12 — 1st search zone; 13 — Cable; 14 — 2nd search zone; 15 — Legend.

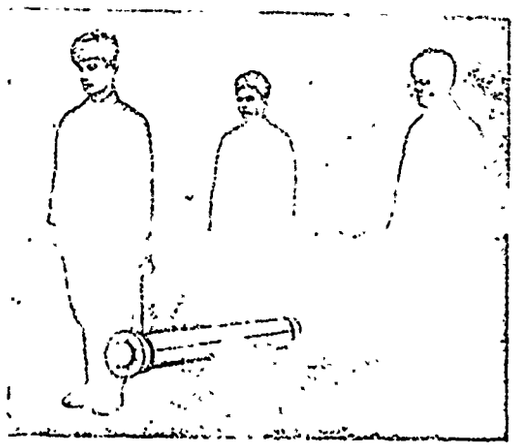

Fig. 82. Position of the bomb detector during the search.

When searching for unexploded mines, bombs or shells underwater the detection device of the bomb detector must be loaded down with additional ballast of 30-35 kilograms that does not contain any ferromagnetic objects in it.

CHAPTER VII

MINEFIELD BREACHING

Under the existing conditions mined obstacles will inevitably be encountered along the path of the advancing troops, especially enemy minefields that cannot be by-passed. It will be necessary to breach these minefields in order to let the advancing units pass.

It is necessary to take into account the fact that the clearing of lanes through the enemy minefields in the course of an advance will have to be carried out within a limited time with minimum reconnaissance of the minefield and preparatory work. A seven man obstacle clearing party is assigned for clearing one lane. This party must be equipped with mine detectors, probes, grapnels, flags, black and white tape, detonation equipment, hand arms, and small tools (knives, wire cutters).

The party assigned to clear lanes through friendly minefields first of all acquaints itself with the minefield records, studies the terrain on which they are situated, determines the exact location of antidisturbance mines and studies other necessary data.

When breaching enemy minefields the party must be acquainted with the data yielded by engineering reconnaissance concerning the location of enemy minefields, with the types of mines used by the enemy as well as with the methods used in installing them.

It is desirable to clear lanes through friendly and enemy minefields along a single axis.

Depending on the situation, the time and the available facilities the lanes may be cleared by hand, by the detonation of explosive charges on the minefield (blasting method), or with the aid of exploders (mechanical method).

The width of the lane depends on the concrete conditions and the mission at hand. It is, for instance, sufficient to clear a lane about a meter wide for the passage of a small infantry unit. Combat and transport vehicles, however, require a lane at least four to six meters wide for one way traffic. Two way traffic requires a lane of

not less than eight-twelve meters in width.

Clearing Lanes by Hand

Lanes through enemy minefields situated along the forward edge of the battle area are cleared by hand. Therefore the clearing of lanes or the removal of individual mines by hand must be carried out covertly, under camouflage. The obstacle removing parties must be covered by fire provided by specially assigned subunits.

The removal of mines and the clearing of lanes through enemy minefields by hand is carried out in cases when it becomes necessary to obtain detailed information on the type of mines and methods of mining, when it is necessary for our reconnaissance patrols or small units to pass unnoticed through the minefield for a surprise attack against the enemy.

When clearing lanes by hand, when the search for individual mines is conducted with a mine detector or a probe, it is necessary to watch with particular attention for any factors of recognition. These factors include: freshly excavated or dried earth, footpaths, small, symmetrically distributed mounds or holes, sections of dried grass, various types of obstacles, markers or warning signs, wire or rope lying on the ground or stretched out, pegs driven into the ground, etc.

The trained eye of the scout can note many other factors of recognition not mentioned above, which will permit him to find both individual mines and entire minefields.

Depending on the availability of the means of reconnaissance, the party searches for mines using the following methods.

In searching for (reconnoitering) mines with mine detectors equipped with probes (Fig. 76) the party is broken up into two man teams each of which covers a strip 1.5 meters wide with its mine detector, as shown in Fig. 83.

When searching for (reconnoitering) mines with the aid of a mine detector without a probe (Fig. 77) the team is lined up in a formation forming a wedge to the right or to the left (Fig. 84). The distance between team members is six-eight meters.

The black and white tapes that stretch out behind the soldiers crawling up ahead, serve to guide those moving to the right and left, behind them, while the black and white tapes that stretch out behind the soldiers crawling along the extreme right and left margins denote the boundaries of the cleared

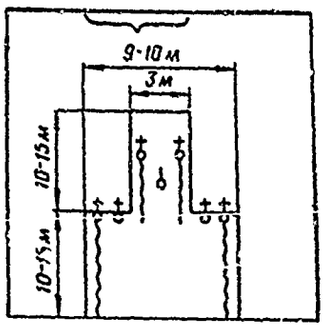

Fig. 83. Combat formation of the party engaged in searching (reconnoitering) for mines.

lane. If the assigned mission involves only the reconnaissance of a minefield only one black and white taps is unreeled approximately along the axis of the sector being reconnoitered. On detecting a mine the combat engineer attaches a tag with his number exactly opposite the point where it is installed and designates the mine with a flag. On the way back the detected mines are moved with the aid of a grapnel or destroyed. The depth of the minefield, the number of rows and the distance between them is determined with the aid of the marked tape. The number of mines found within a certain strip makes it possible to determine the density of the minefield.

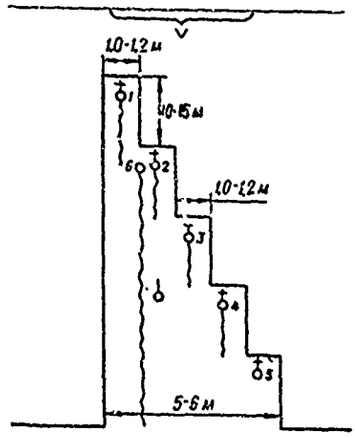

Fig. 84. Combat formation of a party working with a mine detector without a probe.

Depending on the type and method of installation the detected mines are dragged manually with the aid of grapnels beyond the boundaries of the lane that is being cleared, or their position is designated with flags or other standard signs so that they may be detonated without moving.

On each pass the party clears a 10 meter wide lane.

Mines frozen into the ground or ice are destroyed on the spot without any attempt to drag them away.

Mines are extracted from the ground only on the signal of the senior commander. The mines are extracted one after the other beginning with the one farthest away. The sequence in the extraction of mines must be strictly observed. This is necessary to make sure that an accidental mine explosion does not rip the cable (rope) leading to the mines farther up.

It is permitted to attach several grapnels to one cable for the purpose of simultaneous extraction of several mines. In this case the cable has an appropriate number of branches 5-10 meters long each with grapnels on the end. The length of the branches must be different so that all the mines would not be budged at the same time as the cable is pulled.

The extraction both of individual mines and groups of mines with the aid of a grapnel is carried out from a shelter or from a safe distance.

Minefield Breaching Using the Blasting Method

The breaching of minefields using the blasting method involves

the use of individually placed or distributed charges.

Individually placed charges consist mostly of 200-400 gram trinitrotoluene blocks placed either on top of the mine or next to it. They are used for the detonation (destruction) of individual antitank and antipersonnel mines of all types and designs that are installed in the ground or on the ground and camouflaged with a layer of dirt no thicker than 10 cm.

If the mines are located a considerable distance from each other they are destroyed one by one with fire.

If the mines are grouped closely together the individually placed charges are connected with a demolition cord and detonated simultaneously by fire.

The detonation of a 400 gram block on an antitank mine destroys it completely, while a 200 gram block merely damages the mine without detonating it.

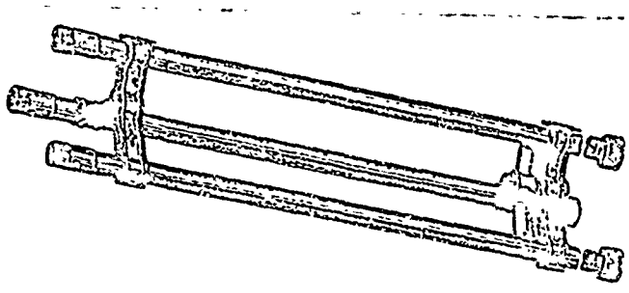

Fig. 85. A section of the UZ-3 linear charge.

The best effect in clearing lanes through minefields is achieved with the aid of linear charges prepared out of trinitrotoluene blocks by the troops themselves, or with the aid of special linear mine clearing charges supplied to the troops, known as demolition "shakes."

The linear charges pushed out into the minefield and detonated destroy antitank and antipersonnel mines within their detonation range. The utilization of linear charges does not require preliminary reconnaissance of the minefield, it is merely necessary to know its boundaries.

Linear charges are now in widespread use and constitute an item of standard issue in all the modern armies. These charges are placed on the minefield both manually and by mechanical means (winches, tanks, rocket engines).

The UZ-3 linear charge rocket engines is assembled out of separate sections. Each section (Fig. 85) consists of three elements linked by collars. The element is a metal tube two meters long with

a diameter of 53 mm filled with an explosive substance. The weight of the explosive substance per linear meter of an assembled charge is 8 kilograms.

Charges up to 50 or 100 meters long are assembled for clearing operations. These charges are installed on the minefield with the aid of a tank which pushes them on to the minefield (the charge in front of the tank) or pulls them (charge behind the tank) with the tank traveling no faster than 10 kilometers per hour. The distance which the UZ-3 charge may be pushed into the minefield is 500 meters. If the pulling method is used the charge may cover a distance of up to three kilometers.

The width of the lane cleared by the detonation of the charge is no more than six meters.

The charge is detonated either electrically or by fire from a safe distance.

The UZ-2 linear charge, just as the UZ-3 linear charge, consists of individual elements of similar length and diameter. The gross weight of each element is 10.2 kilograms, the explosive charge in the element weighs 5.3 kilograms. In order to connect the elements to each other there is a sleeve with outside thread on the end of each element, and a sleeve with inside thread on the other end. The elements are connected by screwing the sleeve with the inside thread of one element to the sleeve with the outside thread on another element.

When necessary the elements of the UZ-2 charge may be used to assemble double and triple element linear charges (Fig. 86), for which purpose the UZ-2 set comes with special collars.

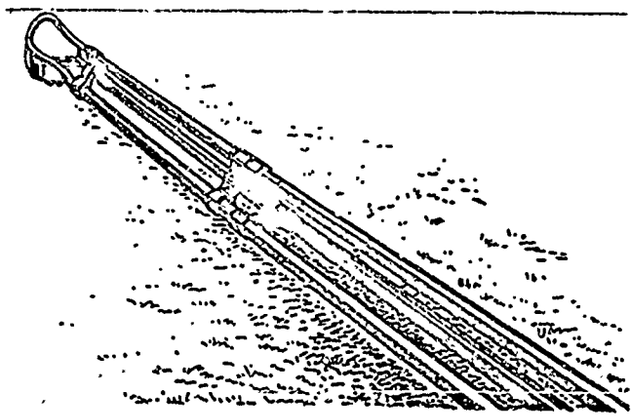

Fig. 86. A triple element UZ-2 linear charge.

Special charge feeding sets (SPZ) are used to move the linear

charges onto the enemy minefields.

The SPZ set contain: a winch, reel of blasting cable with a power source, 16 carts, a roller, a wrench and binding wire.

The introduction of the UZ-2 linear charge with the aid of the SPZ set is carried out by a detachment of soldiers who are stationed in a trench at a distance of not more than 200 meters from the minefield.

In addition to the linear charges of considerable length it is also possible to use short linear charges for clearing lanes through minefields, particularly if no mechanical equipment is available. These short charges consist of 5-7 UZ-2 sections. Such charges are easily introduced into the minefield by hand and detonate in sequence, one after the other, i.e. the first charge is moved out and detonates, it is followed by the second charge, then the third, and so on, until a lane is blasted through the entire minefield.

Along with the standard issue UZ-3 and UZ-2 linear charges the army units may also make their own linear charges out of 200 gram or 400 gram blocks. Depending on the weight of the explosive charge varying numbers of blocks are placed and tied to the board per linear meter of the charge. When assembling a charge of 400 gram blocks 10-20 of them are placed per meter of the board, which comes to 4-8 kilograms of explosives per linear meter of the charge.

Two wheels on an axle may be secured to one of the ends of the board to facilitate the introduction of such a charge into the minefield. A handle is attached to the other end of the board to make the moving of the charge easier. If necessary such charges may be coupled up to make them longer as they are pushed out into the minefield.

The width of the lanes cleared in antitank minefields by the explosion of a linear charge depends on its weight as indicated in the table given below.

Type of charge	Designation of charge	Weight in kg. per linear meter of charge: Explosive	Gross	Width of lane, m	Depth to which charge is introduced, m.: Manually (winch)	Towed by tank
O	Single	2.65	5.1	—	70	—
O O	Double	5.30	11.0	3-4	80	100
O O (on cart)	Double on cart	5.30	13.0	7-8	100	100
O O O	Triple	7.95	16.0	8-10	50	100
O O O (on cart)	Triple on cart	7.95	18.0	10-12	100	100

In the US Army special attention is devoted to the clearing of lanes through minefields by the blasting method, therefore, during the recent years several new types of mine clearing linear charges have been developed there in addition to the standard MTAI bangalore torpedo linear charge, (Figs. 87 and 88).

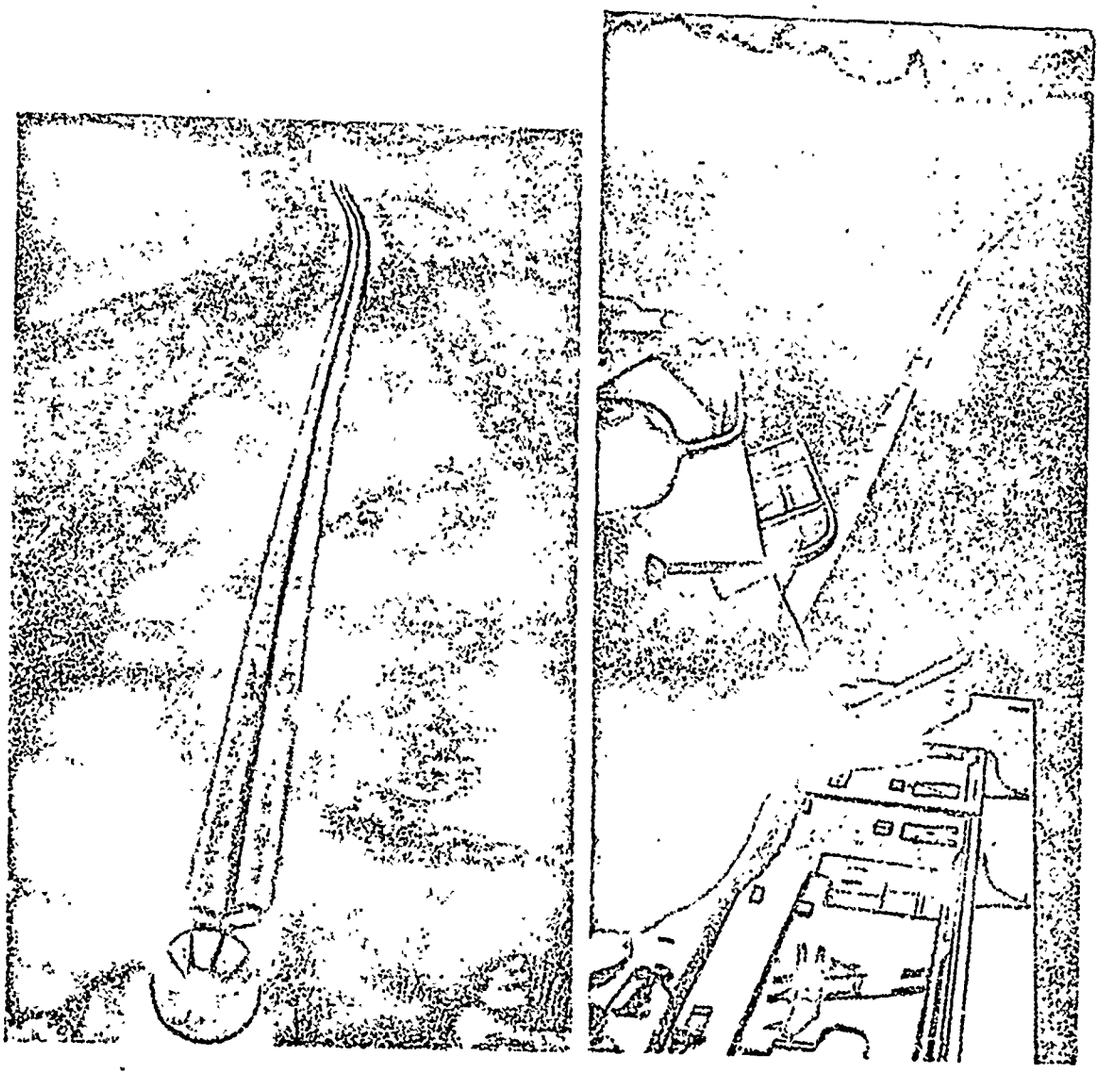

Fig. 88. Linear charge for minefield breaching.

Fig. 87 A linear charge for minefield breaching.

Let us look at some of the linear mine clearing charges used in the US Army.

The M1A1 "bangalore torpedo" mine clearing linear charge appeared during the Second World War. The charge consists of steel pipes 50 mm in diameter and 1.5 meters long screwed together and filled with an explosive substance. A pipe such as this filled with an explosive charge weighs 10.8 kilograms, the explosive substance weighs four kilograms. This charge is used by almost all the armies of the NATO block.

The powerful M2 mine clearing linear charge was created during the postwar period. It weighs 5,700 kilograms, the explosive substance weighs 1,500 kilograms, and it is 100 meters long. The charge is introduced into the minefield by a tank.

The M3 "Snake" mine clearing linear charge is a further perfection of the M2 charge. It is as long as the M2 charge (100 meters), but it weighs 4,000 kilograms, and its explosive load weighs 2,200 kilograms, i.e. the net load of the charge has been increased by two times (from 26% of the M2 charge to 55% of the M3 charge). The M3 charge is introduced into the mine field by a tank or a reaction engine.

The M157 mine clearing linear charge contains 1,500 kilograms of explosives, and is 98 meters long. It is pushed into the minefield by a tank or a rocket engine. The charge is assembled out of individual aluminum sections. According to the press it ensures a 100% cleared lane.

The US Army also has the M173 set consisting of a flexible mine clearing linear charge assembled on a hermetically sealed plastic trailer which may be towed over land or water. The linear blasting M96 charge of the M173 set consists of 800 individual blocks threaded on a steel cable. The charge is 0-90 meters long and weighs 688 kilograms. The explosive substance weighs 600 kilograms or 6.7 kilograms per linear meter of the charge.

The charge is introduced by a solid-propellant rocket engine. The charge is introduced to a depth of 120 meters. Braking is accomplished with the aid of a 30 meter nylon line. The introduction of the charge is fully mechanized and is accomplished by any towing vehicle. The vehicle is manned.

The detonation of the charge clears a lane adequate for tank traffic.

The British Army has a mine clearing linear charge designated "Giant Weiner." This charge, weighing 4,180 kilograms, consists of a solid-propellant rocket engine, a linear blasting charge, a detonating device with a delay pellet and brake chute.

The blasting charge consists of plastite enclosed in a soft shell. The explosive charge weighs 1,360 kilograms, the overall length of the charge is 228 meters, and the length of its active part is 186 meters, i.e. there are 7.4 kilograms of explosive substance per linear meter of the charge.

The charge is introduced in the minefield with the aid of a solid-propellant rocket engine covering a distance of several hundred meters.

The charge is transported on a special trailer.

According to the British press this charge clears a 7.2 meter wide lane through the minefield.

Some countries have light charges for clearing lanes, footpaths, through antipersonnel and antitank minefields. Work is under way in some other countries for the creation of such charges.

The American Army, for instance, has the M1 linear charge for this purpose. The charge is introduced in the minefield from the air by a solid-propellant rocket engine. Its main component is a 120 meter long flexible charge consisting of several intertwined strands of demolition cord.

In flight the rocket engine lays the charge behind it. The charge is wound on a special drum.

On hitting the ground the charge blows up with the aid of a special device thus forming a lane from 0.5-0.6 meters wide, adequate for small troop formations.

The Federal Republic of Germany has worked out a blasting cord for clearing lanes-footpaths up to 60 cm in width in antipersonnel minefields. This cord is also used for reconnoitering antitank minefields. The cord is 80 meters long, and the length of the cleared land is 72 meters. The cord weighs a total of 18 kilograms. The cord is carried and serviced by one soldier. The cord is introduced in the minefield by a solid-fuel rocket engine.

Clearing Lanes by the Mechanized Method

The mechanized method of minefield breaching finds widespread application in addition to the manual and blasting methods. The mechanized method is used particularly to ensure the advance of troops deep in the enemy defense lines.

Tanks equipped with special exploders such as plows, flails, roller exploders, or mine excavators are mainly used for minefield breaching.

Roller exploders, as a rule, have two independent groups (sections) of rollers secured to the front of the tank in line with its tracks. As the exploder is pushed it clears two strips in front of the tank tracks each about 1.2 meters wide. The area between the sections remains uncleared. Tanks following behind may proceed only strictly along the tracks made by the exploder. This is inconvenient and slows down the advance. Therefore two or three tanks with roller exploders are usually assigned to clear a lane through the minefield. The tanks move in a wedge formation at a distance of 25-30 meters from each other, as shown in Fig. 89.

A detachment of combat engineers is assigned to each lane cleared by tanks with exploders. These detachments, if necessary,

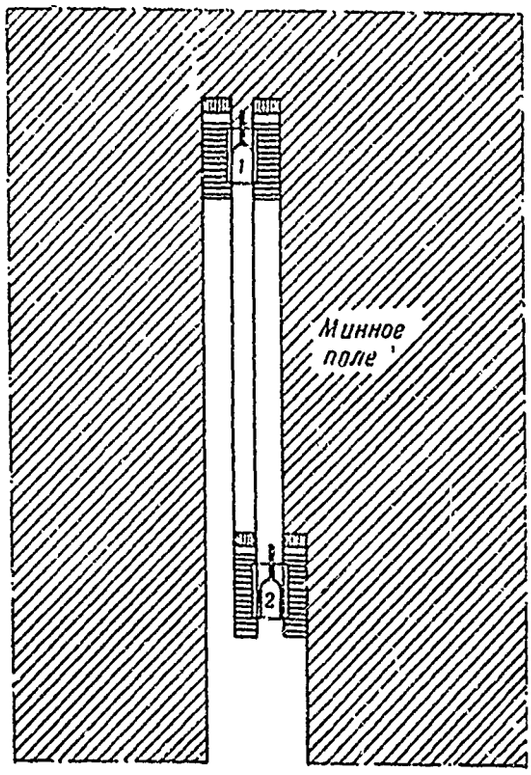

Fig. 89. Minefield breaching with the aid of tanks and exploders.

Legend: 1 -- Minefield.

conduct an additional check of the lane, remove unexploded mines, designate the boundaries of the lane, and, if called for, expand the lane and perform commandant's service.

Let us dwell briefly on the construction of the main types of modern exploders.

The roller exploder (Fig. 90) consists of two similar sections operating independently of each other. Each section, as already mentioned, clears a strip of land in line with the tank tracks. The exploder rollers are made out of especially tough steel that withstands repeated blasts of antitank mines and constitute the working organs of the exploder.

The British "Scorpion" exploder is a typical representative of a flail exploder. This device was used by the army during part of World War II.

The "Scorpion" exploder consists of a steel cylindrical drum installed on brackets in front of the tank. Chains about 1.5 meters in length with weights on the end are secured to the drum. The drum is rotated by auxiliary motors installed inside the tank.

As the drum rotates the chains strike the ground with their weights hitting the mines and detonating them. The clearing rate with this exploder is about one kilometer per hour. This device clears a three meter wide lane.

Fig. 90. A roller exploder.

A dense cloud of dust rises in front of the tank as the flails hit the ground (particularly dry ground). This considerably decreases visibility of the terrain up ahead.

The American tank bulldozer mine clearer is a representative of the mine excavator. As the exploder moves the plows slice the ground and the mines that are encountered are, as it were, plowed out of the ground.

When clearing a lane by the mechanized method it is necessary to remember that the utilization of all types of exploders decreases the speed and maneuverability of the mine-clearing tanks. Therefore the mine-clearing tanks must be covered with artillery or tank fire. In some cases it is possible to use smoke screens for cover.

Designation of Lanes and the Commandant's Service

Every cleared lane through a mined obstacle, if it is used by combat and transport vehicles, must be marked off in some way and have signs easily visible to friendly troops (Fig. 91).

The boundaries of the lane may be designated with a black and white tape secured to the ground or attached to 0.5-0.75 meter high stakes.

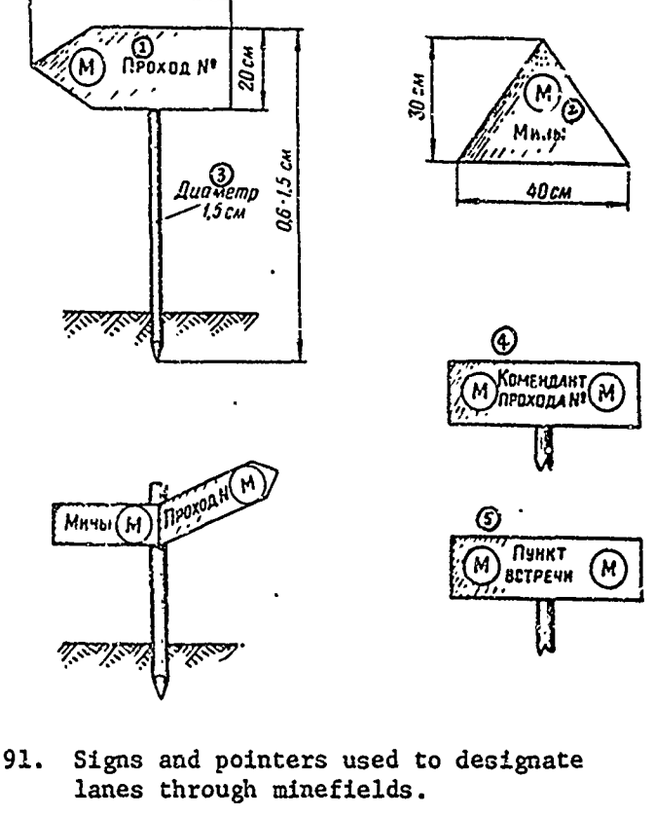

Fig. 91. Signs and pointers used to designate lanes through minefields.

Legend: 1 -- Lane No; 2 -- Mines; 3 -- Diameter; 4 -- Commandant of lane No.; 5 -- Junction.

Lanes through friendly minefields are usually designated by one-sided signs easily visible from the friendly side and invisible from the enemy's side.

In order to camouflage one sided signs it is feasible to install them in small depressions made in the ground and camouflaged with grass, branches, etc. (Fig. 92).

If there is time and if the lane is located a considerable distance away from the enemy, barbed wire is stretched along its boundaries on stakes no higher than one meter. Boundary barriers can also be made out of boards mounted on trestles, turnpikes or other handy materials. The barriers are installed at a distance of 1.5-2 meters from the edge of the minefield.

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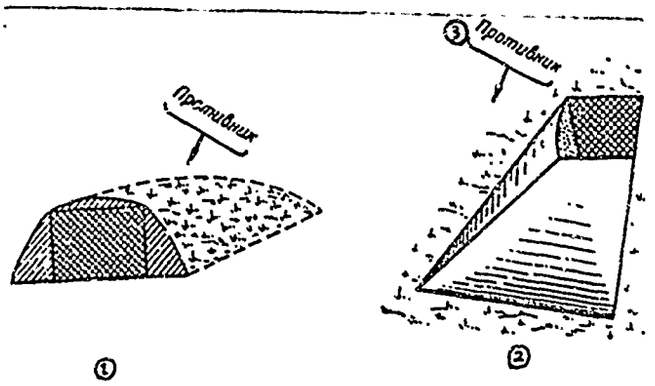

Fig. 92. One sided signs

Legend: 1 -- Installed on terrain covered with dense vegetation; 2 -- Installed on open terrain; 3 -- Enemy.

Warning signs with the notations "Mines" and "Lane" are installed simultaneously with the construction of barriers around the minefield and the lanes. These signs are installed both along the lane and at a certain distance from the minefield (100-200 meters) warning the troops of the presence of mines.

In order to regulate and ensure the safe movement of troops traffic regulation posts are established at the beginning and end of the lane. These posts maintain order and regulate traffic through the lane, and remove stalled vehicles. If the traffic is heavy special patrols may be assigned in addition to the posts. These patrols would operate some distance from the lane (regulating traffic along the approaches to the lane through the minefields).

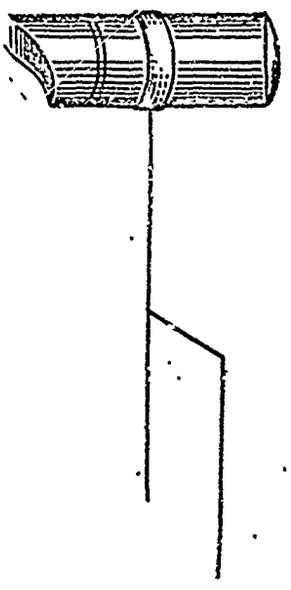

Fig. 93. A light signal marker.

The traffic regulators must have signalling devices in order to control the traffic (flags, flashlights) and should be stationed in areas invisible to the enemy.

The commandant's service has the task of maintaining and repairing the barrier along the lane and along the adjoining sectors of the minefield. It also has the job of installing warning signs, and, in case of necessity, of blocking the lanes with mines.

CHAPTER VIII

METHODS OF TRAINING THE PERSONNEL IN MINING AND DEMINING OPERATIONS

The organization of a proper supply of equipment for the study of mining and demining operations, and of the techniques and methods of installing and breaching obstacles helps the trainees to acquire profound theoretical knowledge and necessary practical experience in the performance of their assigned missions.

Firm theoretical knowledge and practical experience may be acquired only if there is an adequate physical plant available including classrooms, training grounds, small training cities, and expendable items necessary both for the demonstration of various elements in the resolution of different missions, and for the provision of all practical operations on the scale of the established training goal.

Only those training exercises that are well supplied with equipment permit the fulfillment of training requirement which is to train the personnel in whatever is necessary in battle under conditions made as realistic as possible.

Properly organized and well thought out exercises permit the training of the personnel in a consecutive order proceeding from the most elementary and simple subjects to more complex subjects and to the execution of missions by teams, detachments and subunits.

The material part of the mining and demining equipment is studied in the classroom (theoretical part) and in the field (practical part) where mining and demining techniques and methods are worked out. For this purpose the classrooms are equipped with special stands and visual training aids, while the outdoor training areas are broken up into different sectors used in conducting training exercises.

Specially equipped classrooms and training grounds or training cities permit the conduct of high quality training exercises and the self-training of the personnel.

The Equipment of Classrooms and Training Grounds

Fig. 94 shows an example of a training stand for the study of mines and mining techniques. The display stand shows models of domestic antitank and antipersonnel mines and their design. The lower row of illustrations on the display stand shows cross section views of various methods of installing mines in different kinds of ground, in deep and shallow snow. Such display stand is sufficiently graphic and makes it easier for the soldiers and sergeants to study both mining equipment and minelaying methods.

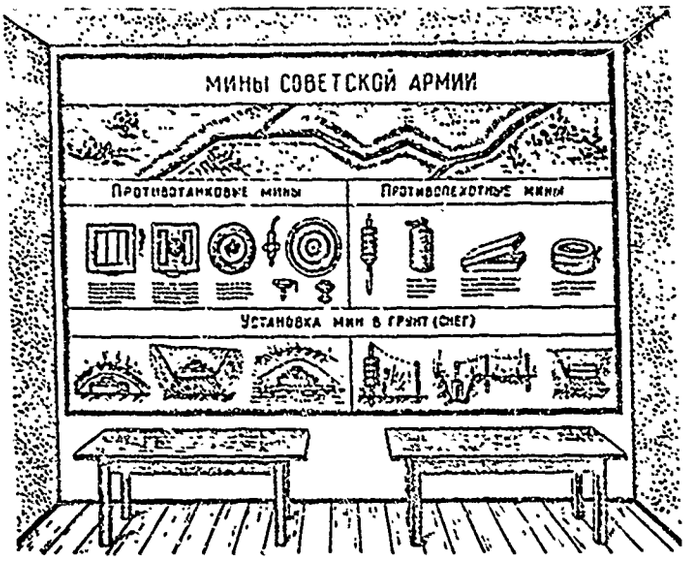

Fig. 94. Display stand showing mining equipment and techniques.

In addition to the specially display stands the classroom must also contain models, cross sections and dummies of antitank, antipersonnel and beach defense mines, fuzes and detonators used in the Soviet Army, as well as models of antitank and antipersonnel mines, fuzes and detonators of the foreign armies, training firing switches and fuzes for antitank and antipersonnel mines.

Models and cross sections of both domestic and foreign models are easy to make using the available posters and blueprints.

Models are best made in two variants: full scale models and cross sectional models made to the scale of 2 : 1 — 5 : 1 depending on the actual size of the mine or fuze.

With a model of a mine it is possible to obtain a general idea of the mine, assimilate methods for its installation and removal,

i.e. to obtain the same practical experience one would get from work with a real mine.

The cross sectional models of mines are used to study the inside structure and the functioning of the different parts of the mine. The cross sectional model permits observation of changes in the position of the various parts of the mine and their interaction at the moment of explosion.

The models must be designed for repeated use.

Fig. 95 shows an overall view of the model of the M25 mine. The body with the fuze is seen to the left, the mine prepared for shipment is seen on the right (the fuze has been replaced with a lid). All the parts of the mine, with the exception of the safety fork and the handle, are made out of wood. It is assembled out of five parts. Part 1 -- the body of the mine, part 2 -- the fuze, detonator and housing, part 3 -- is the firing mechanism (firing pin), part 4 -- striker-retainer balls, part 5 -- the spring. The drawing shows notches in the board. The ball guides slide along these notches. On the opposite side the guides have pins that keep the balls from rolling out. Let us observe the operation of the model.

When pressure is applied on the pressure plate of the fuze the latter descends overcoming the resistance of the spring. The edges of the detonator housing push out the balls into the recesses in the body thus freeing the striper which, under the pressure of the firing spring, strikes the detonator.

To cock the model the striker is pushed down until the notches on it are past the thicker part of the body. Then the balls are raised until they fit into the notches in the striker. After that the striker is released which, under the pressure from the spring rises up with the balls until the latter rest on the detonator housing.

In addition to that there must be in the classroom a set of posters, sketches, blueprints and tables showing the techniques and methods of installing domestic and foreign mines and minefields, the construction of lanes through mined obstacles, the norms pertaining to the installation of mines and minefields, as well as on the reconnaissance of obstacles and their breaching.

It is also desirable to have samples of pointers, flags, black-white tapes and one sided signs for the designation of lanes through minefields, along with mine detectors, probes, grapnels and other devices used in the reconnaissance and clearing of minefields.

The training area if possible is established on bisected terrain. It is desirable to have a forested zone, a zone overgrown with bushes, a dirt road, a level stretch and several hills within th training area.

The training area is broken up into several sectors for training in various techniques and methods of installing individual mines, minefields, recording of minefields, reconnaissance and breaching of minefields.

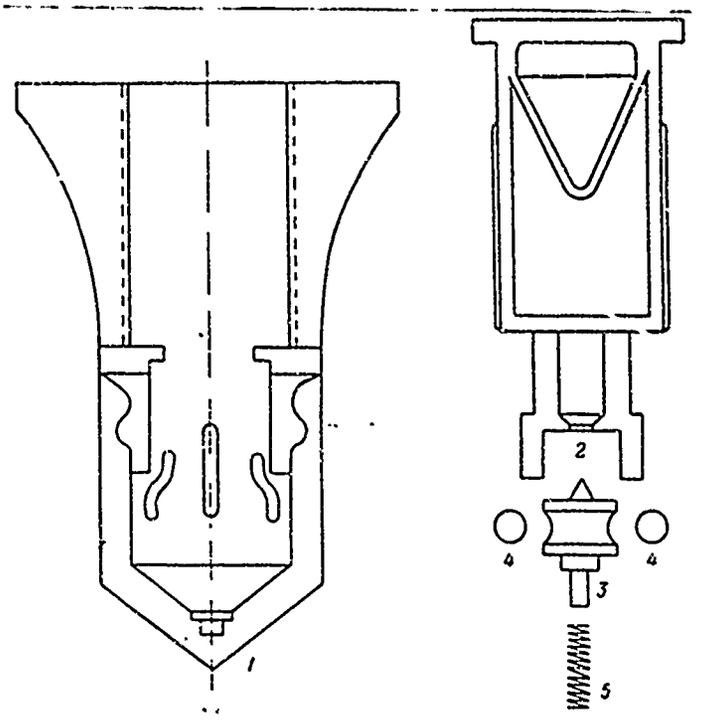

Fig. 95. Cross sectional model of the M25 mine.

Legend: 1 — Body; 2 — Fuze with detonator; 3 — Firing mechanism with firing pin; 4 — striker-retaining balls; 5 — Spring.

How is training to be organized in the designated sectors?

In order to work out methods and techniques of installing individual mines in different types of ground it is necessary to have a demonstration sector with installed antitank and antipersonnel mines serving as a display. In this sector the trainees acquire a practical acquaintance with the installation of mines in terrain covered with sod, in plowed land, sand, compact ground, roads, and swamps, and in the winter they learn how mines are installed in a deep and a shallow snow cover.

From here the trainees may move on to the fulfillment of missions involving the installation of individual mines both in the winter and the summer.

When conducting training on the subject "Installation of the Minefield at Night along a Mine Laying Cord Stretched Perpendicularly to the Front: a trench will be necessary, whose length must be equal to the length of the minefield being installed by the subunit. It is logical that a new trench cannot be dug for each exercise. The trench therefore has to be dug ahead of time and used in training all the subunits.

The same trench may be used for the small (individual) exercises, such as, for instance, the installation of mines along a mining cord by a team.

In this sector it is also possible to practice the installation of a minefield by a detail, and, if the local conditions permit, it is possible to distribute the mines from mine layers or other vehicles.

A special sector with foreign mines (dummy mines) installed in it is used for the purpose of studying the minefield patterns used by the foreign armies, and, in part, for studying the "standard" (cluster) minefield pattern. A cleared and equipped lane is included in the installed minefield.

The same sector is used for training in methods and techniques of reconnoitering and clearing minefields, extracting individual mines, minefield breaching and erecting barricades along these lanes.

If there are not enough dummies of foreign mines domestic mines are used and installed in foreign minefield patterns.

An area will be required for the conduct of training exercises for sergeants on the recording of mined obstacles with the aid of an aiming circle and a range finder.

Training in all the sectors is conducted by platoon and detachment commanders, whereas the training of sergeants in the recording of minefields is conducted by the company commander.

Practice indicates that it is necessary to hold at least three training exercises in order to train the sergeants to work with confidence both during daylight and night hours.

First training sessions -- two hours (held in the classroom).

Training materials: aiming circles -- 2, range finders -- 2, markers, posters and sketches. Time may be broken up as follows: referencing minefields by eye and with instruments -- 15 minutes; recording with the aid of an aiming circle and a range finder -- 35 minutes; independent work with the instruments -- 50 minutes.

At the beginning of the session the instructor stresses the importance of timely referencing of the installed minefields, cites several examples from the Great Patriotic War and from the postwar period when a correctly compiled reference sketch helped to rapidly locate a minefield. He explains the main points involved in minefield referencing using various methods (by eye, with instruments, and with the aid of a range finder and an aiming circle). The instructor also explains the positive elements of each method as well as their shortcomings. After that he explains the design of the instruments and the rules governing their use.

At the end of the first hour the instructor shows how to take correct readings from the aiming circle and the drum, how to record them on the sketch in thousandth divisions of the goniometer and in degrees.

During the second hour of the training session the sergeants work independently with the instruments and compile a minefield

reference sketch under the supervision of the instructor. At the end of the session the instructor assigns homework. For example, azimuths have been measured along with the distances to the angle points of the minefield:

$$\frac{15\text{-}65}{131\ \text{m}}\ ;\ \frac{29\text{-}30}{440\ \text{m}}.$$

It is necessary to compile a minefield reference sketch on the basis of the above.

Second training session lasts four hours (conducted in the field during daylight hours). Training materials: aiming circles -- 2, range finders -- 2, measuring tape -- 405; markers -- 4-5, compasses, field plotting boards, form blanks, pencils, rulers, protractors (one for each team). The personnel are moved to the outdoor training area for training in the recording of minefields, where the points for installation of the instruments have been designated and 4-5 markers have been installed (Fig. 96).

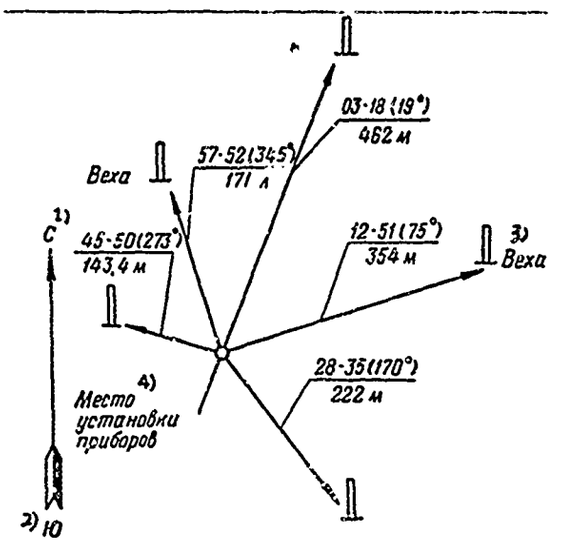

Fig. 96. Area used for training in minefield referencing.

Legend: 1 -- North; 2 -- South; 3 -- Marker; 4 -- Instrument positions.

The commander measures the azimuths and the distances ahead of time.

The exercise is conducted in the following sequence. Training

in measurement of distances and azimuths -- 30-40 minutes; minefield referencing -- 90-100 minutes, location of minefields -- 60 minutes.

First the sergeants take turns in taking measurements. The instructor, who already has precise data on the distances and azimuths, supervises their work and sees to it that the results obtained by the trainees are close to the true figures. Errors must not exceed 0.3 meters for a distance of 150 meters, 0.5 m for 200 meters, 1.0 meters for 300 meters and 3 meters for a distance of 500 meters. Errors in the measurement of azimuths are allowed within the limits of 12 thousandths.

After the exercise the sergeants independently reference the markers to the main or the terrain reference points and compile a sketch. After completing this they switch places. The mined areas are located with the aid of the sketches that have been compiled.

Third training session lasts four hours (it is organized in the same way as the third session, except that this one is held at night). Practice indicates that it is difficult to determine distances at night, therefore the instructor devotes principal attention to work with the range finder.

In order to perfect their experience in minefield recording the sergeants must consolidate it further during any other minefield installation exercises.

Some Advice on the Conduct of Obstacle Breaching Exercises with Tank Crews

During the Great Patriotic War our forces accumulated extensive experience in the breaching of obstacles. Not all this experience, however, is useful under the present day conditions. During the past war, when minefields were primarily installed in the forward areas, the combat engineers cleared 10 meter wide lanes through them ahead of time or, in some cases, removed the entire minefield. The boundaries of the cleared lanes or demined sectors were designated with easily visible signs. These lanes were freely used by tank and other subunits and no one even thought about the need for preliminary training.

Under current conditions, however, the situation is considerably different. Most of the minefields will, apparently, be installed in the course of the battle along the direction of attacking troops. This precludes the reconnaissance of minefields ahead of time, while the rapid advance of the troops will require the clearing of lanes within short periods of time using the blasting or the mechanized method.

Consequently the tank subunits must be trained in crossing minefields along the lanes cleared by the detonation of linear charges or by mine-clearing tanks.

In order to train the tank crews in minefield breaching it is necessary to conduct at least four exercises with them.

The first exercise is conducted in daytime. A mine field based on the standard pattern (See Chapter V) is installed using dummy mines on the training grounds or the tankodrome. A four meter cleared lane is made in the center of the minefield whose axis is designated by the explosion of a linear charge, or by plowing a 30-40 cm wide furrow 10-25 cm deep. A 8-10 meter lane is designated at its entrance with flags or some other signs. Some 50-60 meters from the minefield it is terminated (Fig. 97). Mines crossed off on the sketch are not installed. There should be at least 2-3 practice mines along the right and left boundaries of the lane in direct proximity to the boundaries.

The tank crews participating in the exercise are advised that our troops are mounting an offensive and that in accordance with reconnaissance data antitank minefields have been installed along the front of the enemy defenses. The crews are also advised that lanes have been cleared through the friendly minefields and designated with one-sided signs. That lanes are being cleared through enemy minefields by the blasting method in the course of the artillery preparation, and that their boundaries will not be marked. The axis of the lane will be the trail left by the explosion. The mission is to breach the obstacle within a short period of time.

After that the subunit passes through the designated corridor and then the lane in a column formation on command from the instructor.

The instructor watches whether the crews are acting correctly, and records all instances of tanks hitting the mines. The practice mines that were set off are replaced after the tanks pass through the minefield.

At the post exercise analysis the instructor explains

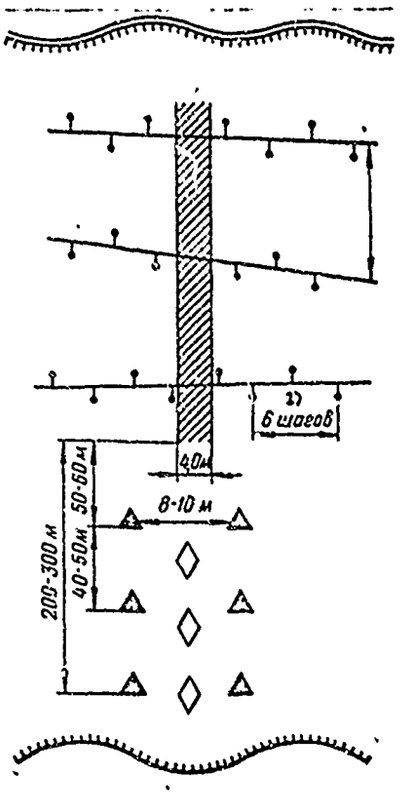

Fig. 97. Breaching the minefield through lane cleared by the detonation of a linear charge.
Legend: 1 -- Paces

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the reasons for various mistakes made during [illegible] exercise and [illegible] how it should be prevented. It is considered [illegible] the crew has fulfilled its mission if the tank remained within the lane on three passes. These exercises may also involve motorized infantry artillery and other subunits equipped with a variety of combat and transport vehicles.

The second training session is also conducted during the daylight hours. During preparations for it a four or six row minefield is installed on unfamiliar terrain. The distance between mines in a row is set at 3.6 and 5.4 meters, while the distance between rows is 15-20 meters. Practice mines are used in this case as well.

The tank unit involved in the exercise must have a mine exploder. A plowshare is used to designate the inside limits of the cleared tracks.

In the exercise area the instructor reviews the situation and issues, for example, the following assignment: "Scattered enemy subunits are retreating in direction X offering resistance along favorable lines and bypassing areas of the terrain accessible to tanks. The tank platoon will execute an assault from march column in direction X and, in collaboration with its neighbor, will seize Y. The direction of further assault is Z. Tank with exploder will be used for clearing lanes through minefields. The other tanks will cross the minefield through the cleared lane without waiting for the arrival of combat engineers."

The tank with the exploder moves at the head of the columns and designates the lane while the other tanks follow behind precisely along the cleared track and cross the minefield.

The instructor watches the tanks moving along the lane and checks to see if any of the tanks deviate from the cleared strips. After the minefield is breached a brief analysis is held and the exercise is repeated in a new area 5-10 meters from the previously cleared strip. The criteria for the performance of the crews is the same as for the first exercise.

The third exercise is held at night in an unfamiliar region. A minefield is installed in the same pattern as that used in the second exercise. Mines that are used in this case must be of the type that give a light signal (signal mine or the UITM-60 mine).

The subunit which includes a tank with an exploder breaches the obstacle in a column formation. After the first mine is detonated under the exploder, the instructor installs a light signal along the axis of the track. A similar signal [illegible] the end of the minefield no closer than 60-70 meters from the one. The tank with the exploder moves strictly in a straight line. The other tanks cross the minefield guiding themselves by the light signals. Experience indicates that night time exercises, particularly with young crew members, have to be repeated several times.

The fourth exercise is conducted both in daylight and night hours. The minefields are installed ahead of time in the same patterns used for the preceding exercises.

The first exercise is heard in daytime. While approaching the training area the subunit is deployed into a combat formation. The tanks proceed at intervals of 50-75 meters. The tank with the exploder travels at the head of the column and clears a lane through the minefield. The other crews find out that there is a minefield ahead after the first mine detonates under the exploder, move out behind the tank with the exploder and proceed along its tracks (Fig.98). After that they are again deployed into a combat formation. The exercise requires particular attention on behalf of the crews. A mine from any row may detonate under the exploder, and the tanks without exploders which delay in moving to the tracks made by tank with the exploder, or start deploying into the combat formation too early, may be "destroyed."

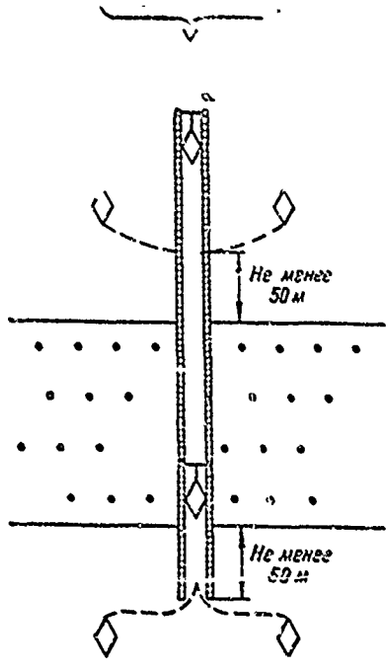


Fig. 98. Crossing the minefield through lane cleared by a tank with an exploder.
Legend: Not less than 50 meters

The second exercise is held at night.

The tank crews which get sufficient practice at the exercises may cross minefields through lanes cleared by various means rapidly, confidently and without losses.

CHAPTER IX

SAFETY RULES TO BE FOLLOWED IN MINING AND DEMINING OPERATIONS

All precautionary measures must be strictly observed in mining and demining operations, along with the safety rules, and the proper sequence and order must be followed in doing the work.

The smallest violation of precautionary measures and safety rules established for mining and demining operations may threaten not only the life of the person guilty of the violation, but also the lives of others. Moreover the combat (training) mission will not be properly completed which may disrupt the operation planned by the command.

Below are some basic safety rules and advice which must be observed both in training and in the combat utilization of mining and demining equipment.

The first and most important requirement is to always remember that one is dealing with explosive substances. There is a saying that "the combat engineer can make only one mistake." If he makes a mistake, i.e. does not observe precautionary measures or violates the safety rules he will either be killed or maimed.

Another important requirement stems from the above -- each subunit commander before the start of operations must instruct the subunit (group or individual soldiers) even if the personnel had previously performed these operations. The commander must once again make certain that the personnel have a knowledge of the equipment with which they will be working, and are familiar with the precautionary measures necessary for the execution of the operation.

A sergeant, officer or a private is always appointed [illegible] all training exercises (in the classroom or the field) as the instructor who bears the full responsibility for the fulfillment of the assignment, for the correct installation of mines and the strict observance of precautionary measures and safety rules.

The instructor issues an assignment to each soldier (team),

instructs them and indicates the sequence in which the assignment is to be fulfilled if this was not previously done by the subunit commander. The instructor controls the fulfillment of the assignment, and even helps the trainees with the assignment in the most dangerous or key phases.

The teams and detachments assigned to mining or demining operations must have a firm knowledge of the engineer explosive items with which they will have to work (including the enemy engineer explosive items) in the given sector of the terrain, and must also have practical experience in mining and demining work.

During the mining or demining operation strict discipline is observed along with good organization and the established sequence.

Every soldier on the minefield must have a firm knowledge of what he must do, how to do it and in what sequence.

All the actions of the team or individual soldier are performed only on command or signals given by the instructor.

Teams without a firm knowledge of the engineer explosive items, who are unfamiliar with mining or demining techniques, are not allowed to engage in these operations.

The most experienced and disciplined soldiers are assigned to the clearing of antipersonnel minefields.

During the mining or demining operations it is necessary to organize the proper storage, accounting and issue (receipt) of engineer explosive items. For this purpose stationary or mobile (temporary) field dumps with specially assigned storemen may be established.

If there is a large stock of engineer explosive items in the temporary dump, or if mining operations are carried out in different directions engineer explosive items are issued to the detachment (team) with an appropriate notation on the issue sheet. The issue sheet is kept by the storeman and is forwarded to the unit after the engineer explosive items have been used up.

Explosives, ammunition and detonation devices are used only for the purpose they were designed for.

In installing or disarming mines by hand only those operations are performed in the specified sequence that are necessary and justified for the given mine using the tools (wrenches, crew drivers) that are part of that particular mine set.

To prepare the TM-46 mine with the MVM fuze for installation, for instance, it is necessary to:

Unscrew the plug in the mine;

Make certain that the fuze safety pin is in the proper position (the pin must be inserted to the point where the [illegible] against the curved edge of the fuze cover and is held firmly in that position.

Examine the MD-6 detonator. If the fuze came without the detonator, it is then necessary to screw the detonator into the fuze;

Screw the fuze into the fuze well by hand until it is seated firmly against the rubber gasket.

In order to install this mine by hand it is necessary:

Dig a mine hole and install the fully armed mine in it

Remove the safety pin from the fuze;

Camouflage the mine.

In order to disarm the American M19 antitank mine it is necessary to:

Carefully remove the camouflage layer of dirt;

Move the mine from the point where it was installed with the aid of a grapnel;

Match the arrow on the arming plug with the letter "S" (with the aid of a special wrench);

Carefully remove the fuze from the mine;

Screw the detonator out of the fuze.

When loading, unloading or moving engineer explosive items they must be treated gently. Each soldier should not carry explosive loads weighing more than 30 kilograms.

It is prohibited to carry engineer explosive items on the shoulder or the back.

When mining or demining an area it is necessary to observe the following precautionary measures and safety rules.

In mining operations:

It is necessary to insert the fuze into the mine with a smooth movement without sharp movements or jolts. The fuze must be screwed in as far as possible but without applying special force or using tools with the exception of the ones specified for the given mine;

A mine with a poorly installed or incompletely screwed in fuze must not be installed in the minefield;

Imperfect mines cannot be installed in the minefield;

The safety pin must be removed from the fuze with a short motion without jerks or special effort. If necessary the free end may be used to support the fuze without pressing on it,

When camouflaging the mine care must be taken not to shake it or press on its lid or fuze;

When installing a mine by hand from the prone position it is necessary to assume a position convenient for work, and, if necessary, for self defense as well;

Every mine that is installed must be recorded, and if necessary, marked on the minefield map.

In demining operations:

It is always necessary to treat explosive items or objects containing explosive or pyrotechnical (incendiary) substances with care;

Before doing anything to the detected mine or shell it is necessary to examine the area around it;

It is possible to disarm only those mines whose design is well known;

Any loosely stretched wires, twine or ropes must not be pulled or tugged. Tightly stretched wires or ropes must not be cut;

It is dangerous to lift or move enemy equipment, weapons, or personal items since they may all be booby trapped;

It is not permitted to detonate explosives without specfic orders;

It is necessary to work in a calm and confident manner, without haste or commotion. It is important to perform the operations specified for disarming the mine of the given design;

If a mine of an unknown design or a booby trap is found, its position is marked, without moving the device itself. The commander (person in charge) is advised of such a find;

The accumulation of unnecessary personnel is prohibited during the disarming of a mine;

Should doubts or difficulties be encountered in the course of a demining operation a report is immediately made to the subunit commander (or to the individual in charge);

Foot traffic outside the cleared lanes or over unchecked ground is prohibited;

Mines may be moved with a grapnel only from a shelter or a safe distance.

Supplement 1

APPROXIMATE TIME NORMS FOR THE INSTALLATION OF ANTITANK AND ANTIPERSONNEL MINEFIELDS

Consecutive numbers	Type of operation	Installation of mines by a squad, number of mines installed per hour	in 10 hours	Installation of mines by a platoon, number of mines installed in 3 hours	in 10 hours
1	Installation of an antitank minefield using mine layers:				
	A. With subsequent installation of mines in mine holes and camouflage by hand:				
	Using one mine layer	80	700	-	-
	Using three mine layers	-	-	200	1,500
	B. Without camouflaging mines:				
	Using one mine layer	200	1,500	-	-
	Using three mine layers	-	-	450	3,600
2	Installation of an antitank minefield using trucks:				
	A. With subsequent installation of mines in mine holes and camouflage by hand:				
	Using one truck	70	600	-	-
	Using three trucks	-	-	180	1,300
	B. Without camouflaging mines:				
	Using one truck	180	1,300	-	-
	Using three trucks	-	-	500	[illegible]
3	Installation of antitank minefield by a detail:				
	In mine holes with camouflage	40	300	120	900
	Without camouflage	100	750	230	1,7[illegible]

Supplement 1 (Continued)

4	Installation of an antitank mine field along a mining cord stretched perpendicularly to the front	25	90 in 5 hours	70	300 in 5 hours
5	Installation of an antipersonnel minefield by a detail or along a mining cord stretched parallel to the front pressure action mines	180	1,300	400	3,000
6.	Same as above along a mining cord stretched perpendicular to the front	35	100 in 5 hours	120	450 in 5 hours
7.	Installation of an antipersonnel mine field along a mining cord stretched parallel to the front using pull action mines	30	270	90	700

Supplement 2

SHIPPING SPECIFICATIONS OF ENGINEER EXPLOSIVE ITEMS

Consecutive numbers	Type of item	Exterior dimensions of shipping crate, mm	Weight of loaded crate, kg.	Number of items in the crate	Number of containers in crate and items in container	Note
1	MD-2 detonator	550X490X170	20.2	600	4X150	Metal container has 15 cardboard boxes with 10 detonators in each
2	MD-5m detonator	550X490X170	22	600	4X150	Same as above
3	MD-2 detonator	425X340X155	15	720	2X360)	Packed in the old way
4	MD-5m detonator	425X340X155	15	720	2X360)	
5	MUV-2 (MUV) fuze, unarmed	550X490X170	20	150	3X50	Three containers with fuzes
6	MUV-2 (MUV) fuze with MD-2 detonator	550X490X170	20	150	3X50	Three containers with fuzes.
				150	1X50	One container with fuzes
7	MUV fuze, unarmed	425X340X155	30	720	2X360	
8	MUV-2 fuze, unarmed	520X410X180	23	360	2X18	

Supplement No. 2 (Continued)

9	VPF fuze, unarmed	550X490X170	17	200	4X50	In metal container with 10 cardboard boxes each
10	Same as above	610X400X200	22	360	2X18	The crate contains space for containers with MD-2 detonators -- 360 detonators
11	TM-46 antitank mine	750X350X410	56	5		Crate contains: 4 TM-46 mines and one TMN-46 mine
	MVM fuze	665X330X270	30	80	2X40	
	MD-6 and MD-6n detonators	425X340X155	15	864	2X432	Cardboard box contains: 5 MD-6 detonators and ne MD-6n detonator
12	TMD-B antitank mine	1035X395X420	70	6		
13	TMD-44 antitank mine	1035X395X420	67	6		
	MV-5 fuze	550X490X170	21	200	4X50	Cardboard box contains five fuzes; metal container has 10 cardboard boxes
	Training smoke cartridge	570X400X330	35	60	10X6	

Supplement 2 (Continued)

14	Practice UITM-60 antitank mine	860X425X370	60	5		
	UIMV-60 fuze	615X560X190	39	30		
	Signal cartridge		65	320	4X80	
	Electric primer	525X525X240	27	800	4X200	20 in a cardboard box; metal container has 10 boxes.
	Electrical inputs	615X585X190	24	30		
	Adapters	850X445X330	45	1		
15	PMD-6 anti personnal mine	1,000X550X285	40	100		
		1,000X550X285	43	100		
	Practice UPMD-6 cartridge	570X400X330	38	180	12X15	15 cartridges in each cardboard pack
16	POMZ-2m (POMZ-2) antipersonnel mine	855X405X250	50	22		55 bodies, 54 wooden pegs, 22 snap hooks with loop, and 176 meters of wire
	Practice UPOMZ-2 cartridge	570X400X330	27	360	24X15	15 cartridges in each paper package

Supplement 2 (Continued)

17	Signal mine	470X295X395	40	60	6X10	Cardboard box contains 10 mines, 10 pegs, 10 MUV fuzes and 10 snap hooks with wire
18	400 and 200 grams trinitro-toluene blocks	490X350X250	32	25 kg		

Supplement 3

To be destroyed if capture threatened

ANTIPERSONNEL AND ANTITANK MINEFIELD RECORD FORM

No. _____

(according to minefield pattern)

Installed _____
(indicate area where installed)

Map ~~(scale)~~ _____ Sheet _____ Coordinates _____

1. Installed on the order of _____

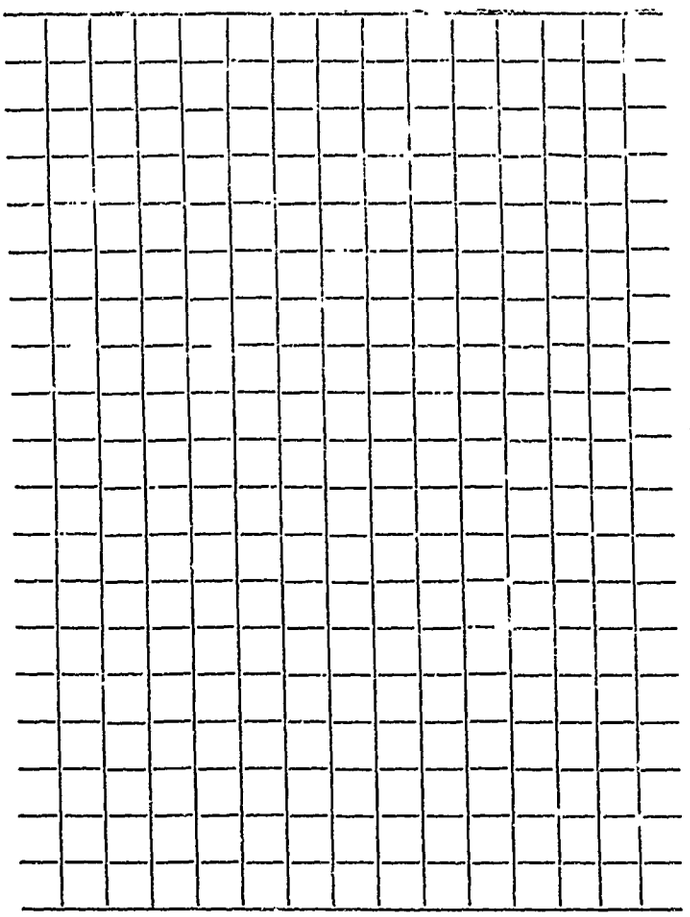
_____
(Post, grade, last name, initials)

2. Date minefield was installed _____

3. Mines armed (removed) on order of _____

_____
(Post, grade, last name, initials)

MINEFIELD REFERENCE SKETCH



Scale: 1 cm = 50 or 100 meters (1:5,000 or 1:10,000)

Minefield reference sketch will include:

1. Azimuths and distances from the main or the landmark reference points to the minefield angle points.
2. Referencing of landscape reference points to the [illegible] reference point.
3. Number of mine rows, distance between rows, mine spacing.

LEGEND

1. Reference points: No. 1_____

No. 2_____

No. 3_____

2. Type of mines_____ Explosive_____

3. Total number of mines in the minefield_____

4. Conditions and method of installation_____
(kind of ground,

_____
depth at which installed, method of installation)

5. Antidisturbance mines_____
(indicate number and designation on sketch,

_____
method of installation in antidisturbance position)

6. Description of minefield_____
(number of rows, distance between

_____
rows, mine spacing, number of mines per row)

7. Installation of mines was supervised and recording carried out by

_____
(Post, grade, last name, name and patronymic)

_____
(Signature)

8. Clear lanes left in minefield (width, designation, type of cover)

_____

9. Completed record form checked by _____

_____
(Post, grade, last name, initials, signature)

Date_____

10. Compiled in _____ copies

Distribution _____

11. Receipt of the commander of the line unit taking over the minefield guard and defense duties_____
(Post, grade, last name,

_____
initials, signature)

Notes on clearing of the minefield:

1. On whose orders

2. Date

3. Minefield was cleared by _____
Post, grade, last name, initials, signature)

Note on Change in Minefield Status

Date	New minefield status	On whose order was the status changed	Enemy losses

Note on the Acceptance and Release of Minefield

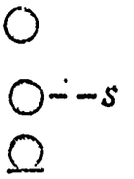
Date	Who released the minefield	Who accepted the minefield	Notes on receipt and release
	(Grade, last name, signature)	(Grade, last name, signature)	

Individuals Familiarized with the Boundaries (Cleared Lanes) of the Minefield

Date	Post and subunit	Grade, last name and initials	Signature indicating familiarization with boundaries (lanes)

Supplement 4

SYMBOLS



Antitank mine

Controlled mine

Mine with extra charge (additional charge or a charge of increased power)

Incendiary (napalm) mine

Pressure action antipersonnel mine

Pull action antipersonnel mine

Antipersonnel fragmentation (bounding) mine

Gas mine

Illumination-signal mine (flare)

Mine of unknown design

Antidisturbance antitank mine

Booby trap

Coastal mine

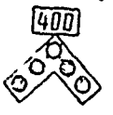
Coupled antidisturbance antitank mine

Lane through obstacle for motor vehicles

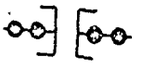
Lane through obstacle for infantry

Booby trapped area

Dummy minefield



Composite minefield



Gap in an obstacle up to 90 meters wide

END